Agricultural Research Institute
PUSA

PROCEEDINGS

OF THE

AMERICAN PHILOSOPHICAL SOCIETY

HELD AT PHILADELPHIA

FOR

PROMOTING USEFUL KNOWLEDGE

Vol XXXIII

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PROCEEDINGS

OF THE

AMERICAN PHILOSOPHICAL SOCIETY,

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Vol. XXXIII. JANUARY, 1894. No. 144.

January 5, 1894.

The annual election for Officers and Councilors was held this afternoon between the hours of 2 and 5 P.M. The result was submitted to the Society at the evening meeting by the officers of the election.

Stated Meeting, January 5, 1894.

President, Mr. FRALEY, in the Chair.

Prof. W. H. Appleton, a lately elected member, was presented and took his seat.

Correspondence was submitted as follows:

A circular was received from the Nederlandsche Maatschappij ter bevordering van Nijverheid, Harlem, offering a prize for 1894.

Accessions to the Library were reported from the Australasian Association for the Advancement of Science, Sydney; Institut Egyptien, Cairo, Egypt; Anthropological Society, Tokyo, Japan; Friesch Genootschap van Geschied, etc., Leeuwarden; Société R. de Géographie, Antwerp, Belgium; Société Hongroise de Géographie, Budapest; Siebenburgische Verein fur Naturwissenschaften Hermannstadt, Transylvania, Physiologische Gesellschaft Messrs R Friedlander und Sohn, Berlin, Prussia Verein fur Erdkunde K Sachs Alterthums Verein, Dresden Saxony K Leopoldinisch Carolinische Deutsche Akademie der Naturforscher Halle a S Prussia Deutsche Seewarte Hamburg, Germany, K Sachs Gesellschaft der Wissenschaften Leipzig K B Akademie der Wissenschaften, Munich Bavaria Society of Arts Royal Astronomical Society, Editors of *Nature* Royal Society, Meteorological Society, Prof Joseph Prestwich London Eng Literary and Philosophical Society, New Castle upon Tyne, Eng Geological Survey of Canada Ottawa Bureau of Statistics of Labor, Athenæum The family of the late John Pickering Boston, Mass Harvard College, Mr A McFarland Davis, Cambridge, Mass American Antiquarian Society Worcester, Mass, The Travelers Insurance Company, Hartford, Conn Editor of the *Archæological Magazine* Meriden, Conn Yale University, Editors of *American Journal of Science*, New Haven, Conn, American Institute of Electrical Engineers, Mathematical Society, Meteorological Observatory, Editor of the *Popular Science Monthly*, Prof J A Allen, New York, N Y, Free Public Library, Jersey City N J Geological Survey of New Jersey, Trenton, American Chemical Society, Easton Pa, Editors of the *Medical News* College of Pharmacy, University of Pennsylvania Messrs Julius F Sachse, Henry Phillips, Jr, Philadelphia Editor of the *American Chemical Journal*, Baltimore, Md, U S Geological Survey, Hydrographic Office, Commissioner of Labor, Bureau of Statistics, Washington, D C, State Board of Health Nashville, Tenn Academy of Science, St Louis, Mo Geological Publishing Company, Minneapolis, Minn, Kansas Academy of Science, Topeka, Kans, Academy of Science Tacoma, Wash, Agricultural Experiment Stations, Pennsylvania State College, Knoxville, Tenn, Madison, Wis, Laramie, Wyo, Sociedad Cientifica "Antonio Alzate," Observatorio Astronomico Nacional de Tacubaya, Mexico, Mex, Société Scientifique du Chili, Santiago

Photographs for the Society's Album were received of Messrs. R Meade Bache and Thomas M Cleemann

The following deaths were announced

George de Benneville Keim Philadelphia, December 18 1893, æt 64

Dr Charles M Cresson Philadelphia December 27 1893, æt 66

Dr Dionys Stuer Vienna October 9 1893

The President having been authorized to appoint suitable persons to prepare the usual obituary notices subsequently appointed Dr Daniel G Brinton for Mr Keim

The officers of the election held this afternoon pursuant to the laws of the Society reported the following members had been elected as Officers and Council of the Society for the ensuing year

President

Frederick Fraley

Vice Presidents

F Otis Kendall W S W Ruschenberger, J P Lesley

Secretaries

George F Barker Daniel G Brinton Henry Phillips, Jr,
George H Horn

Curators

Patterson DuBois, J Cheston Morris, R Meade Bache

Treasurer

J Sergeant Price

Councilors for Three Years

**William P Tatham, George B Morehouse, Samuel Wagner,
William C Cattell**

Councilor for Two Years, in place of Thomas H. Dudley, deceased.

Henry Hartshorne.

Mr Henry Phillips, Jr, was renominated for Librarian, and the nominations were closed.

Dr. Daniel G. Brinton read a paper on "Nagualism."

Mr. Lyman read a paper on "The Age of the Newark Brownstone."

Dr. Cope presented a communication on the fishes of Rio Grande do Sul.

Pending nominations Nos 1268, 1269, 1270, 1271, 1272, 1273, 1274 were read.

The report of the Finance Committee was presented and the appropriations for the year were passed.

The Michaux Committee presented the following report and resolution, which were adopted:

The Michaux Committee of the American Philosophical Society respectfully reports, that at a meeting held on December 14, 1893, a letter was received from Dr. J T Rothrock enclosing list of the time and subjects proposed for the Fifteenth Course of Lectures for 1894, given under the auspices of the American Philosophical Society

MONDAY EVENINGS.

Jan 22. Pennsylvania Forests and Forest Trees (Illustrated).
" 29. Protection of Pennsylvania Forests.
Feb. 5. Waste of Pennsylvania Forests (Illustrated).
" 12. Possibilities of Forest Restoration.
" 19. Legal Relations of our Forests.
" 26. Trees in Cities and Towns (Illustrated).
March 5. Waste Lands of the Commonwealth (Illustrated).

The Lectures will be delivered in the Pennsylvania University Building, which has been kindly tendered to him for the purpose. He estimates the cost of the lectures at $240.

The Committee approved of Dr. Rothrock's proposition, and asks for the passage by the Society of the following resolution:

"*Resolved*, That the sum of two hundred and forty dollars be appropriated out of the income of the Michaux Fund for the expenses of the Fifteenth Course of the Michaux Forestry Lectures by Prof J T Rothrock

By order of the Committee

J SERGEANT PRICE *Secretary*

The Librarian reported that Dr Elliott Coues had returned personally all the Lewis and Clarke manuscripts borrowed by him, that the same were correct in number and condition that Dr Coues had arranged them in a most excellent and careful manner, so as to facilitate all future reference, in fact, that they were in much better condition than when loaned by the Society

The Treasurer was authorized to receive from the city of Philadelphia the sum of $3000 due January 1, 1894, and to sign proper quittances therefor

And the Society was adjourned by the President.

Age of the Newark Brownstone

By Benj Smith Lyman

(Read before the American Philosophical Society, January 5 1894)

There seems to be reasonable ground for doubt whether the rock beds of the Newark, N J brown building stone quarries belong even to the Mesozoic as they have generally been thought to In spite of the unfavorable character of the sandstone for preserving fossils, it has yielded a number of specimens, and the identification of at least two species has been attempted In the *New Jersey State Geological Report* for 1879, p 26 the late deeply lamented State Geologist Prof Cook speaks of certain fossils at the closely adjacent Belleville quarries, evidently in the same sandy beds, as follows citing the unexcelled authority of Lesquereux

"At the Belleville quarries thin seams of coal and impressions of the stems and branches of plants are not uncommon A fragment of the stem of a plant with surface markings like the Lepidodendron was found, and is now the property of Mr David Hitchcock, of Orange. It is a very plainly marked, flattened stem eight inches long four and one-half inches wide, and one and one half inches thick Photographs of this were taken and sent to Prof. L Lesquereux, of Columbus, Ohio. He returns the following answer

"'The photographs are sufficient, if not for specific determination, at least for positive reference of the specimens to Lepidodendron Even I should say that the specimens represent *L weltheimianum* Presl as distinctly as a specific representation can be made upon a decorticated trunk of Lepidodendron *L weltheimianum* is a leading species of the old red sandstone found here, as in Europe, from the subcarboniferous measures down to the Devonian, while until now we do not have any remains of Lepidodendron of any kind from the upper coal measures (Permo carboniferous), or from higher up than the Pittsburg coal

"'*L weltheimianum* is recorded only once from the true coal measures, this by Eichwald, from the Carboniferous sandstone of Russia But European authors, among others Goeppert, doubt the identity of the Russian species with *L weltheimianum*, which is moreover extremely variable, and has been described already under about thirty different names'

"Another fragment [Prof Cook adds] has since been obtained from the same quarries by Dr Skinner, of Belleville, and is now in our possession. It is seven inches long, five and one-half inches wide, and one and one-half inches thick, and is as plainly marked as the first Other and smaller specimens somewhat like the above have also been found in the quarries in Newark If these fossils are sufficient to determine the geological age of these beds, they put it in the upper Carboniferous, at least, which is lower than has heretofore been claimed for it. A larger and more complete collection of such fossils must be made if possible

"Vegetable impressions are found in large numbers at the quarries of Mr. Smith Clark, of Milford, but most of them are fragmentary and indistinct Those which can be seen plainly enough for identification resemble the Equisetum and some coniferous plants. They are evidently much newer than the fossils at Newark and Belleville"

It is not to be wondered at that the very sagacious Prof Cook should have perceived this great difference in age on even so cursory an examination; for the Newark brownstone is at least some nine thousand feet lower geologically than the Milford beds, a part of the Perkasie shales of Pennsylvania. Few species indicating the geological age have been reported from the Milford beds, but from the horizon of the Gwynedd and Phœnixville dark shales, far below those of Milford, and quite above the Newark beds, appear to have come most of the fossils in Pennsylvania, Virginia, North Carolina, and elsewhere, that have been thought to indicate the Rhætic age of all the older Mesozoic rocks of those States

So fixed has become the impression of the Mesozoic age of all the beds that have hitherto commonly been grouped together under the name of the American New Red, and many other names, that it may even possibly have caused some bias in the minds of paleontologists in their determination of more or less doubtful fossils; though Lesquereux seems not to have been fettered by such a prejudice to the extent of blindness to otherwise clear indications Prof William M Fontaine may have been guided by equally clear indications, but his expressed argument does not seem perfectly sound when he says of a "New Red" fossil described and figured by Emmons as a Lepidodendron, and without pointing out what else it is "These impressions are, of course, not those of Lepidodendron, as this plant does not exist in the Mesozoic" That would decidedly seem to be begging the question as to the age of the fossil Newberry appears also to have been possibly influenced by the same assumption.

It has, in fact, been generally, but perhaps too superficially, assumed from the predominance mainly of a red color, and the absence of notable unconformities in the beds of the so called New Red, and the lack of numerous convenient fossil indications, that the beds all belonged to one formation of no wide paleontological range, and consequently of no very great thickness Now that our Pennsylvania investigations prove beyond a doubt that the total thickness is at least some twenty seven thousand feet, the presumption is rather that the beds should be of very diverse geological age, and even it should not seem surprising if the lower ones, including the Newark brownstone, should prove to be of Paleozoic age

Lesquereux's very positive, unhesitating recognition of the Lepidodendron would of itself make it highly probable that the brownstone was at least as old as the Carboniferous, and somewhat confirmatory wholly independent fossil evidence has been found in Pennsylvania Several years ago Mr. S E. Paschall, of Doylestown, pointed out to Prof Henry Carvill Lewis certain calamite fossils that had been found by Mr John S Ash half a dozen miles easterly from Doylestown, just north of the old Paleozoic island, so to speak, and within the limits of the supposed Mesozoic, and now known to be a couple of thousand feet geologically below the brownstone beds Lewis thought the calamite might be of Permian age With much search Mr. Ash succeeded in finding a specimen that contained two joints with the whole internode, some twelve or fifteen inches long, and some eight inches or more broad, and it was sent to Lesquereux for identification Other affairs through the short remainder of his busy life prevented Lesquereux from communicating any result of his examination, and the specimen has not yet been recovered. But Mr Paschall has a less perfect fragment ten inches long, indicating a calamite of at least six inches in breadth, with a single joint at two inches from one end He says there are other better specimens at the Academy of Natural Sciences.

The only two recorded fossils, both plants, that have been supposed to be identified beyond doubt, from the Newark quarries, are the *Dioönites longifolius* and *Clathropteris platyphylla*, mentioned by Newberry in his Monograph xiv, of the *U S Geological Survey*, on "The Fossil Fishes and Fossil Plants of the Triassic Rocks," etc, 1888, pp 93 and 94. Fontaine speaks of the *Dioönites longifolius* among the North Carolina fossils, *U. S. Geological Survey*, Monograph vi, 1883, p. 111, judging merely by a description and figure of Emmons', as probably nearly allied to *Zamites* *proximus* from the Rajmahal group of India (Jurassic) and in describing the *Clathropteris platyphylla* from the Virginia coal measures (probably corresponding in age to the Gwynedd and Phœnixville shales and decidedly later than the Newark beds) points out (p 56) several differences between it and the European Jurassic plant with which on the whole he thinks it should be associated Newberry (Monograph xiv p 94) says that fragments of the *Clathropteris platyphylla* have been obtained though only rarely from the beds of Newark but the one he figures is from Milford N J that is some nine thousand feet above the Newark beds

Newberry mentions (p 86) also an imperfect Newark fossil that in reviewing the literature of the Triassic flora (an expression that seems to show his inclination to assume *a priori* that the Newark beds were necessarily Mesozoic) he found to resemble the *Equisetum meriani* but he candidly adds Until the fructification of these Equisetoid plants shall be found which will permit a better comparison with those of older and later formations it is a useless expenditure of time to discuss the question whether they are species of *Calamites* which have survived from the Carboniferous age are true *Equiseta* or are species of an extinct genus of that family

Newberry further speaks of a fossil tree trunk found frequently in the sandstone quarries of Newark resembling *Lepidodendron* adding in regard to the idea of its being one This is a manifest error *Lepidodendron* did not pass from the Carboniferous to the Mesozoic age Evidently he took it in advance for granted that the beds of Newark could not be older than Mesozoic It is not unlikely these very fossils are of the species so readily identified by Lesquereux with the *Lepidodendron* Newberry thinks they are probably a *Palissya*, and Fontaine mentions *Palissya indica* a plant of the Rajmahal group as occurring in North Carolina

Apparently no other fossils have been recorded as coming from Newark and it is seen that only two of them have been identified with any approach to certainty Moreover neither of the two would seem to be so closely like the nearest European and Indian forms as altogether to preclude the possibility of their being of very different age from them especially considering their geographical remoteness

Rogers in his *Final Report on the Geology of Pennsylvania* 1858 Vol ii p 507 suggests the possibility of finding Permian fossils among the highest rocks of Greene county in the southwestern corner of the State , and Stevenson in his *Report of the Second Geological Survey of Pennsylvania* 1876 shows (p 85) that the highest known rocks there are red shales Whether Carboniferous or Permian, it is by no means inconceivable that they may prove to be contemporaneous with the Newark beds

The Canadian geologists have found that much of the formerly so called Trias of Prince Edward Island New Brunswick and Nova Scotia is really Permian Permo carboniferous or even Carboniferous (see the *Canada Geological Survey Reports* Ells 1882–84 1885 Fletcher, 1886, 1890–91). Their description of the rock-beds shows a good deal of resemblance to those of Newark. Fletcher, in his last report, gives several detailed sections of Permian rocks up to five thousand and eight thousand feet in thickness. It seems hardly probable that no traces of so vast a formation should be found in the eastern United States near either the Mesozoic or Paleozoic rocks with which it is so intimately associated in Nova Scotia and Prince Edward Island.

It would seem, then, that the Mesozoic age of the beds of Newark is not so thoroughly certain but that it might be worth while for paleontologists to reëxamine with renewed care the indications of the fossils that really bear on the point. For undoubtedly the very scanty and imperfect testimony of the fossils already known; the apparent bias, on the one hand, in favor of comparing them only with Mesozoic forms that are extremely remote at best; on the other hand, the less biased partial identification of some Newark fossils with Paleozoic ones under conditions at least equally favorable as regards skill and material; the great thickness of measures below the comparatively well identified Rhætic or Triassic horizon of the Gwynedd and Phœnixville shales, the same probably as the Richmond and North Carolina coal bearing beds; and the possibility, to say the least, that some of the red beds conformably at the top of the Carboniferous rocks of southwestern Pennsylvania and of West Virginia, as well as some of the Permian or Carboniferous beds of eastern Canada, may be of identical age with the Newark beds; all these circumstances make it seem not altogether improbable that the Newark brownstone is older than the Mesozoic.

Further on the Age of the Newark Brownstone.

By Benjamin Smith Lyman.

(Read before the American Philosophical Society, January 19, 1894.)

An additional reason for doubting the Mesozoic age of the Newark brownstone may be found in the remarks of Newberry on his fossil plant *Dendrophycus triassicus*, found at Portland, Conn., in sandstone of possibly the same age as the Newark brownstone. He quotes (Monograph xiv, p. 89) Lesquereux's description of *Dendrophycus Desorii*, found in the Pennsylvania No. XI, or Umbral shales; and adds: "I have copied this description nearly entire because it is almost literally applicable to a plant represented on Pl. xxi of this memoir and obtained from the sandstones of Portland, Conn. When we consider the vast interval of time between the deposition of the Umbral shale of Pennsylvania and that of the Rhætic sandstone of Connecticut, one the base of the Carboniferous system and the other the summit of the Trias it cannot fail to be regarded as interesting and surprising that the resemblance should be so complete But for the *a priori* improbability that a species of seaweed should be so long lived I should hardly feel justified in giving even a new specific name to the Triassic specimens Possibly a comparison of more material would show differences not now perceptible but the peculiar mode of growth and the details of structure seem to be essentially the same In the Portland sandstones as in the Umbral shales the fronds of Dendrophycus are enrolled in masses that suggest cabbage heads of large size and rather loose texture while the mode of subdivision and the character of the final ramifications of the fronds are so like that with the similarity of the enclosing rock the specimens from the two localities and horizons are almost undistinguishable

It seems clear that the Portland *Dendrophycus* if viewed without prejudice would like the Belleville and Newark *Lepidodendron* strongly indicate the Paleozoic age of the brownstone

It is not yet certain however whether the Portland sandstone and the Newark brownstone are of the same age for the Portland beds are near the eastern edge of the so called Mesozoic rocks of Connecticut that have generally easterly dips so that the beds have sometimes been taken to be near the top of the column while the Newark beds are no doubt towards the bottom of the so called Mesozoic of New Jersey Still the geological structure in Connecticut has not been so thoroughly worked out as to make that position of the Portland beds perfectly sure Percival s map would seem rather to indicate that they are on the eastern side of a basin and Dana (*Am Jour Sci* 1891 Vol xlii p 446) says the sandstone at Portland is nearly horizontal and occasionally the dip is westerly It seems then not impossible that some of the lower more ancient beds have here come to the surface It is not yet known either how great may be the total thickness of the Connecticut Mesozoic so called nor to what parts of the New Jersey and Pennsylvania rocks it may correspond But the lithological character as well as the decidedly Paleozoic look of the only determined fossil of the Portland beds go somewhat strongly to show an identity in age with the Newark brownstone

At any rate the paleontological argument for the Mesozoic age of all parts of the so called New Red is plainly not so perfect as it has often been supposed to be

Nagualism. A Study in Native American Folk-lore and History

By Daniel G. Brinton, M.D.

(Read before the American Philosophical Society, Jan'y 5, 1894.)

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1. The words *nagual*, *nagualism*, *nagualist*, have been current in English prose for more than seventy years; they are found during that time in a variety of books published in England and the United States;* yet are not to be discovered in any dictionary of the English language; nor has *Nagualism* a place in any of the numerous encyclopædias or "Conversation Lexicons" in English, French, German or Spanish.

This is not owing to its lack of importance, since for two hundred years past, as I shall show, it has been recognized as a cult no less powerful than mysterious, which united many and diverse tribes of Mexico and Central America into organized opposition against the government and the religion which had been introduced from Europe; whose members had acquired, and were bound together by, strange faculties and an occult learning, which placed them on a par with the famed thaumaturgists and theodidacts of the Old World; and which preserved even into our own days the thoughts and forms of a long suppressed ritual.

In several previous publications I have referred briefly to this secret sodality and its aims,† and now believe it worth while to collect my scattered notes and present all that I have found of value about the origin, aims and significance of this Eleusinian Mystery of America. I shall trace its geographical extension and endeavor to discover what its secret influence really was and is.

2. The earliest description I find of its particular rites is that which the historian Herrera gives, as they prevailed in 1530 in the province of Cerquin, in the mountainous parts of Honduras. It is as follows:

"The Devil was accustomed to deceive these natives by appearing to them in the form of a lion, tiger, coyote, lizard, snake, bird, or other animal. To these appearances they apply the name *Naguales*, which is as much as to say, guardians or companions; and when such an animal dies, so does the Indian to whom it was assigned. The way such an alliance was formed was thus: The Indian repaired to some very retired spot and there appealed to the streams, rocks and trees around him, and weeping, implored for himself the favors they had conferred on his ancestors He then sacrificed a dog or a fowl, and drew blood from his tongue, or his ears, or other parts of his body, and turned to sleep Either in his dreams or half awake, he would see some one of those animals or birds above mentioned, who would say to him, 'On such a day go hunting and the first animal or bird you see will be my form, and I shall remain your companion and *Nagual* for all time' Thus their friendship became so close that when one died so did the other, and without such a *Nagual* the natives believe no one can become rich or powerful."[*]

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* These words occur a number of times in the English translation published at London in 1822 of Dr. Paul Felix Cabrera's *Teatro Critico Americano*. The form *nagual* instead of *nahual* or *naual* or *naxal* has been generally adopted and should be preferred.

† For instance, in "The Names of the Gods in the Kiche Myths," pp. 21, 22, in *Proceedings of the American Philosophical Society*, 1881; *Annals of the Cakchiquels*, Introduction, p. 46; *Essays of an Americanist*, p. 170, etc.

This province of Cerquin appears to have been peopled by a tribe which belonged to the great Mayan stock, akin to those which occupied most of the area of what is now Yucatan, Tabasco, Chiapas and Guatemala [†] I shall say something later about the legendary enchantress whom their traditions recalled as the teacher of their ancestors and the founder of their nation. What I would now call attention to is the fact that in none of the dialects of the specifically Mexican or Aztecan stock of languages do we find the word *nagual* in the sense in which it is employed in the above extract, and this is strong evidence that the origin of Nagualism is not to be sought in that stock.

3. We do find, however, in the Nahuatl language, which is the proper name of the Aztecan, a number of derivatives from the same root, *na*, among them this very word, *Nahuatl*, all of them containing the idea "to know," or "knowledge." The early missionaries to New Spain often speak of the *naualli* (plural, *nanahualtin*), masters of mystic knowledge, dealers in the black art, wizards or sorcerers. They were not always evil-minded persons, though they seem to have been generally feared. The earliest source of information about them is Father Sahagun, who, in his invaluable History, has the following paragraph :

"The *naualli*, or magician, is he who frightens men and sucks the blood of children during the night He is well skilled in the practice of this trade, he knows all the arts of sorcery (*navalloti*) and employs them with cunning and ability ; but for the benefit of men only, not for their

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[*] *Historia de las Indias Occidentales*, Dec. iv, Lib. viii, cap. 4.

[†] More especially it is the territory of the Chorti dialect, spoken to this day in the vicinity of the famous ancient city of Copan, Honduras. Cerquin lies in the mountains nearly due east of this celebrated site. On the Chorti, see Stoll, *Zur Ethnographie der Republik Guatemala*, pp. 106–9.

> injury. Those who have recourse to such arts for evil intents injure the bodies of their victims, cause them to lose their reason and smother them. These are wicked men and necromancers."*

It is evident on examining the later works of the Roman clergy in Mexico that the Church did not look with any such lenient eye on the possibly harmless, or even beneficial, exercise of these magical devices. We find a further explanation of what they were, preserved in a work of instruction to confessors, published by Father Juan Bautista, at Mexico, in the year 1600.

> "There are magicians who call themselves *teciuhtlazque*,† and also by the term *nanahualtin*, who conjure the clouds when there is danger of hail, so that the crops may not be injured. They can also make a stick look like a serpent, a mat like a centipede, a piece of stone like a scorpion, and similar deceptions. Others of these *nanahualtin* will transform themselves to all appearances (segun la aparencia), into a tiger, a dog or a weasel. Others again will take the form of an owl, a cock, or a weasel, and when one is preparing to seize them, they will appear now as a cock, now as an owl, and again as a weasel. These call themselves *nanahualtin*."‡

There is an evident attempt in this somewhat confused statement to distinguish between an actual transformation, and one which only appears such to the observer.

In another work of similar character, published at Mexico a few years later, the "Road to Heaven," of Father Nicolas de Leon, we find a series of questions which a confessor should put to any of his flock suspected of these necromantic practices. They reveal to us quite clearly what these occult practitioners were believed to do. The passage reads as follows, the questions being put in the mouth of the priest:

> "Art thou a soothsayer? Dost thou foretell events by reading signs, or by interpreting dreams, or by water, making circles and figures on its surface? Dost thou sweep and ornament with flower garlands the places where idols are preserved? Dost thou know certain words with which to conjure for success in hunting, or to bring rain?
>
> "Dost thou suck the blood of others, or dost thou wander about at night, calling upon the Demon to help thee? Hast thou drunk *peyotl*, or hast thou given it to others to drink, in order to find out secrets, or to discover where stolen or lost articles were? Dost thou know how to speak to vipers in such words that they obey thee?"§

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* Bernardino de Sahagun, *Historia de la Nueva España*, Lib. x, cap. 9.

† Derived from *teciuhtlaza*, to conjure against hail, itself from *teciuh*, hail. Alonso de Molina, *Vocabulario Mexicano*, sub voce.

‡ Bautista, *Advertencias para los Confesores*, fol. 112 (Mexico, 1600).

§ Nicolas de Leon, *Camino del Cielo*, fol. 111 (Mexico, 1611).

4. This interesting passage lets in considerable light on the claims and practices of the nagualists. Not the least important item is that of their use of the intoxicant, *peyotl*, a decoction of which it appears played a prominent part in their ceremonies. This is the native Nahuatl name of a certain plant, having a white, tuberous root, which is the part employed. It is mentioned as "pellote" or "peyote" in the *Farmacopea Mexicana* as a popular remedy, but its botanical name is not added. According to Paso y Troncoso, it is one of the Compositæ, a species of the genus *Cacalia*.[*] It is referred to in several passages by Father Sahagun, who says that it grows in southern Mexico, and that the Aztecs derived their knowledge of it from the older "Chichimecs." It was used as an intoxicant.

> "Those who eat or drink of this *peyotl* see visions, which are sometimes frightful and sometimes ludicrous The intoxication it causes lasts several days The Chichimecs believed that it gave them courage in time of danger and diminished the pangs of hunger and thirst "[†]

Its use was continued until a late date, and very probably has not yet died out. Its composition and method of preparation are given in a list of beverages prohibited by the Spanish authorities in the year 1784, as follows:

> "*Peyote* · Made from a species of vinagrilla, about the size of a billiard ball, which grows in dry and sterile soil The natives chew it, and throw it into a wooden mortar, where it is left to ferment, some leaves of tobacco being added to give it pungency They consume it in this form, sometimes with slices of *peyote* itself, in their most solemn festivities, although it dulls the intellect and induces gloomy and hurtful visions (sombras muy funestas)."[‡]

The *peyotl* was not the only herb prized as a means of casting the soul into the condition of hypostatic union with divinity. We have abundant evidence that long after the conquest the seeds of the plant called in Nahuatl the *ololiuhqui* were in high esteem for this purpose. In the Confessionary of Father Bartholomé de Alva the priest is supposed to inquire and learn as follows:

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[*] Paso y Troncoso, in *Anales del Museo Nacional de Mexico*, Tom. iii, p. 180

[†] Sahagun, *Historia de Nueva España*, Lib x, cap. 29, and Lib xi, cap. 7. Hernandez has the following on the mysterious properties of this plant "Illud ferunt de hac radice mirabile (si modo fides sit vulgatissimæ inter eos rei habenda), devorantes illam quodlibet præsagire prædicereque, velut an sequenti die hostes sint impetum in eos facturi? Anne illos felicia maneant tempora? Quis supellectilem, aut aliud quidpiam furto subripuerit? Et ad hunc modum alia, quibus Chichimecæ hujusmodi medicamine cognoscendis." Franciscus Hernandus, *Historia Plantarum Novæ Hispaniæ*, Tom, iii, p. 71 (Ed, Madrid, 1790)

[‡] *Diccionario Universal*, Appendice, Tom. i, p. 360 (Mexico, 1856).

> "*Question* Hast thou loved God above all things? Hast thou loved any created thing, adoring it, looking upon it as God, and worshiping it?
>
> "*Answer* I have loved God with all my heart, but sometimes I have believed in dreams, and also I have believed in the sacred herbs, the *peyotl*, and the *ololiuhqui*, and in other such things (*onicnellocac in temictli, in xiuhtzintli, in peyotl, in ololiuhqui, yhuan in occequitlamantli*)' [*]

The seeds of the *ololiuhqui* appear to have been employed externally. They were the efficient element in the mysterious unguent known as "the divine remedy" (*teopatli*), about which we find some information in the works of Father Augustin de Vetancurt, who lived in Mexico in the middle of the seventeenth century. He writes·

> "The pagan priests made use of an ointment composed of insects, such as spiders, scorpions, centipedes and the like, which the neophytes in the temples prepared. They burned these insects in a basin, collected the ashes, and rubbed it up with green tobacco leaves, living worms and insects, and the powdered seeds of a plant called *ololiuhqui*, which has the power of inducing visions, and the effect of which is to destroy the reasoning powers. Under the influence of this ointment, they conversed with the Devil, and he with them, practicing his deceptions upon them. They also believed that it protected them, so they had no fear of going into the woods at night.
>
> "This was also employed by them as a remedy in various diseases, and the soothing influence of the tobacco and the *ololiuhqui* was attributed by them to divine agency. There are some in our own day who make use of this ointment for sorcery, shutting themselves up, and losing their reason under its influence, especially some old men and old women, who are prepared to fall an easy prey to the Devil."[†]

The botanist Hernandez observes that another name for this plant was *coaxihuitl*, "serpent plant," and adds that its seeds contain a narcotic poison, and that it is allied to the genus *Solanum*, of which the deadly night-shade is a familiar species. He speaks of its use in the sacred rites in these words:

> "Indorum sacrifici, cum videri volebant versari cum superis, ac responsa accipere ab eis, ea vescebantur planta, ut desiperent, milleque phantasmata et demonum observatium effigies circumspectarent."[‡]

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[*] *Confessionario Mayor y Menor en lengua Mexicana*, fol. 8, verso (Mexico, 1634).

[†] Vetancurt, *Teatro Mexicano*, Trat. iii, cap 9.

[‡] Hernandez, *Historia Plantarum Novæ Hispaniæ*, Tom. iii, p 32.

Of the two plants mentioned, the *ololiuhqui* and the *peyotl*, the former was considered the more potent in spiritual virtues "They hold it in as much veneration as if it were God," says a theologian of the seventeenth century.* One who partook of these herbs was called *payni* (from the verb *pay*, to take medicine); and more especially *tlachixqui*, a Seer, referring to the mystic "second sight," hence a diviner or prophet (from the verb *tlachia*, to see).

Tobacco also held a prominent, though less important, place in these rites. It was employed in two forms, the one the dried leaf, *picietl*, which for sacred uses must be broken and rubbed up either seven or nine times; and the green leaf mixed with lime, hence called *tenextlecietl* (from *tenextli*, lime).

Allied in effect to these is an intoxicant in use in southern Mexico and Yucatan, prepared from the bark of a tree called by the Mayas *baal-che*. The whites speak of the drink as *pitarilla*. It is quite popular among the natives, and they still attribute to it a sacred character, calling it *yax ha*, the first water, the primal fluid. They say that it was the first liquid created by God, and when He returned to His heavenly home He left this beverage and its production in charge of the gods of the rains, the four Pah-Ahtuns †

5. Intoxication of some kind was an essential part of many of these secret rites. It was regarded as a method of throwing the individual out of himself and into relation with the supernal powers. What the old historian, Father Joseph de Acosta, tells us about the clairvoyants and telepaths of the aborigines might well stand for a description of their modern representatives:

> "Some of these sorcerers take any shape they choose, and fly through the air with wonderful rapidity and for long distances. They will tell what is taking place in remote localities long before the news could possibly arrive. The Spaniards have known them to report mutinies, battles, revolts and deaths, occurring two hundred or three hundred leagues distant, on the very day they took place, or the day after

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* Dr. Jacinto de la Serna, *Manual de Ministros de Indios para el Conocimiento de sus Idolatrias y Extirpacion de Ellas*, p. 163. This interesting work was composed about the middle of the seventeenth century by a Rector of the University of Mexico, but was first printed at Madrid, in 1892, from the MS furnished by Dr. N Leon, under the [illegible] of the Marquis de la Fuensanta del Valle

† MSS. of the Licentiate Zetina, and *Informe* of Father Baeza in *Registro Yucateco*, Tom. I.

> "To practice this art the sorcerers, usually old women, shut themselves in a house, and intoxicate themselves to the degree of losing their reason. The next day they are ready to reply to questions "*

Plants possessing similar powers to excite vivid visions and distort the imagination, and, therefore, employed in the magical rites, were the *thiuimeezque*, in Michoacan, and the *chaouaco*, in lower California.†

6 In spite of all effort, the various classes of wonder-workers continued to thrive in Mexico. We find in a book of sermons published by the Jesuit Father, Ignacio de Paredes, in the Nahuatl language, in 1757, that he strenuously warns his hearers against invoking, consulting, or calling upon "the devilish spell-binders, the nagualists, and those who conjure with smoke."‡

They have not yet lost their power; we have evidence enough that many children of a larger growth in that land still listen with respect to the recitals of the mysterious faculties attributed to the *nanahualtin*. An observant German traveler, Carlos von Gagern, informs us that they are widely believed to be able to cause sicknesses and other ills, which must be counteracted by appropriate exorcisms, among which the reading aloud certain passages of the Bible is deemed to be one of the most potent §

The learned historian, Orozco y Berra, speaks of the powers attributed at the present day to the *nahual* in Mexico among the lower classes, in these words

> "The *nahual* is generally an old Indian with red eyes, who knows how to turn himself into a dog, woolly, black and ugly. The female witch can convert herself into a ball of fire; she has the power of flight, and at night will enter the windows and suck the blood of little children. These sorcerers will make little images of rags or of clay, then stick into them the thorn of the maguey and place them in some secret place; you can

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* Acosta, *De la Historia Moral de Indias*, Lib v, cap. 26.

† Of the *thiuimeezque* Hernandez writes. "Aiunt radicis cortice unius unciæ pondere tuso, atque devorato, multa ante oculos observare phantasmata, multiplices imagines ac monstrificas rerum figuras, detegique furem, si quidpiam rei familiaris subreptum sit." *Hist. Plant. Nov Hispan*, Tom. iii, p. 272. The *chacuaco* and its effects are described by Father Venegas in his *History of California*, etc.

‡ "In Mictlan Tetlachihuique, in Nanahualtin, in Tlahuipuchtin." Paredes, *Promptuario Manual Mexicano*, p 128 (Mexico, 1757). The *tlahuipuchtin*, "those who work with smoke," were probably diviners who foretold the future from the forms taken by smoke in rising in the air. This class of augurs were also found in Peru, where they were called *Uirapiricos* (Balboa, *Hist. du Perou*, p. 28–30)

§ Von Gagern, *Charakteristik der Indianischer Bevölkerung Mexikos*, s. 125.

be sure that the person against whom the conjuration is practiced will feel pain in the part where the thorn is inserted. There still exist among them the medicine men, who treat the sick by means of strange contortions, call upon the spirits, pronounce magical incantations, blow upon the part where the pain is, and draw forth from the patient thorns, worms, or pieces of stone. They know how to prepare drinks which will bring on sickness, and if the patients are cured by others the convalescents are particular to throw something of their own away, as a lock of hair, or a part of their clothing. Those who possess the evil eye can, by merely looking at children, deprive them of beauty and health, and even cause their death.' [*]

7. As I have said, nowhere in the records of purely Mexican, that is, Aztecan, Nagualism do we find the word *nagual* employed in the sense given in the passage quoted from Herrera, that is as a personal guardian spirit or tutelary genius. These tribes had, indeed, a belief in some such protecting power, and held that it was connected with the day on which each person is born. They called it the *tonalli* of a person, a word translated to mean that which is peculiar to him, which makes his individuality, his self. The radical from which it is derived is *tona*, to warm, or to be warm, from which are also derived *tonatiuh*, the sun. *Tonalli*, which in composition loses its last syllable, is likewise the word for heat, summer, soul, spirit and day, and also for the share or portion which belongs to one. Thus, *to-tonal* is spirit or soul in general; *no-tonal*, my spirit; *no-tonal in ipan no-tlacat*, "the sign under which I was born," *i. e.*, the astrological day-sign. From this came the verb *tonalpoa*, to count or estimate the signs, that is, to cast the horoscope of a person; and *tonalpouhque*, the diviners whose business it was to practice this art.[†]

These *tonalpouhque* are referred to at length by Father Sahagun.[‡] He distinguishes them from the *naualli*, though it is clear that they corresponded in functions to the nagualistic priests of the southern tribes. From the number and name of the day of birth they forecast the destiny of the child, and stated the power or spiritual influence which should govern its career

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[*] *Historia Antigua de Mexico*, Tom. ii, p. 25. Francisco Pimentel, in his thoughtful work, *Memoria sobre las Causas que han originado la Situacion Actual de la Raza Indigena de Mexico* (Mexico, 1864), recognizes how almost impossible it is to extirpate their faith in this nagualism. "Conservan los agueros y supersticiones de la antigüedad, siendo cosa de fe para ellos, los *nahuales*," etc., p. 200, and comp. p. 145.

[†] On these terms consult the extensive *Dictionnaire de la Langue Nahuatl*, by Rémi Siméon, published at Paris, 1885. It is not impossible that *tona* is itself a compound root, including the monosyllabic radical *na*, which is at the basis of *nagual*.

[‡] Sahagun, *Historia de Nueva España*, Lib. iv, *passim*, and Lib. x, cap. 9.

The *tonal* was by no means an indefeasible possession. It was a sort of independent *mascotte*. So long as it remained with a person he enjoyed health and prosperity; but it could depart, go astray, become lost; and then sickness and misfortune arrived. This is signified in the Nahuatl language by the verbs *tonalcaualtia*, to check, stop or suspend the *tonal*, hence, to shock or frighten one; and *tonalitlacoa*, to hurt or injure the *tonal*, hence, to cast a spell on one, to bewitch him.

This explains the real purpose of the conjuring and incantations which were carried on by the native doctor when visiting the sick. It was to recall the *tonal*, to force or persuade it to return; and, therefore, the ceremony bore the name "the restitution of the *tonal*," and was more than any other deeply imbued with the superstitions of Nagualism. The chief officiant was called the *tetonaltiani*, "he who concerns himself with the tonal." On a later page I shall give the formula recited on such an occasion.

8. There is some vague mention in the Aztec records of a semi-priestly order, who bore the name *naualteteuctin*, which may be translated "master magicians." They were also known as *teotlauice*, "sacred companions in arms." As was the case with most classes of the *teteuctin*, or nobles, entrance to the order was by a severe and prolonged ceremony of initiation, the object of which was not merely to test the endurance of pain and the powers of self-denial, but especially to throw the mind into that subjective state in which it is brought into contact with the divine, in which it can "see visions and dream dreams." The order claimed as its patron and founder Quetzalcoatl, the "feathered serpent," who, it will be seen on another page, was also the patron of the later nagualists.*

The word *naualli* also occurs among the ancient Nahuas in composition as a part of proper names; always with the signification of "magician," as in that of Nanalonaubtla, a chief of the Chalcos, meaning "wizard-stick," referring probably to the rod or wand employed by the magi in conjuration* So also *Naualac*, the "wizard water," an artificial lake not far from the city of Mexico, surrounded by ruined temples, described by M. Charnay.†

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* See Ch. de Labarthe, *Revue Américaine*, Serie II, Tom. II, pp. 222-225. His translation of *naualteteuctin* by "Seigneurs du génie" must be rejected, as there is absolutely no authority for assigning this meaning to *naualli*.

9. The belief in a personal guardian spirit was one of the fundamental doctrines of Nagualism; but this belief by no means connotes the full import of the term (as Mr. H. H. Bancroft has erroneously stated) The calendar system of Mexico and Central America, which I have shown to be substantially the same throughout many diverse linguistic stocks,‡ had as one of its main objects, astrological divination By consulting it the appropriate nagual was discovered and assigned, and this was certainly a prominent feature in the native cult and has never been abandoned.

In Mexico to day, in addition to his special personal guardian, the native will often choose another for a limited time or for a particular purpose, and this is quite consistent with the form of Christianity he has been taught. For instance, as we are informed by an observant traveler, at New Year or at corn-planting the head of a family will go to the parish church and among the various saints there displayed will select one as his guardian for the year. He will address to him his prayers for rain and sunshine, for an abundant harvest, health and prosperity, and will not neglect to back these supplications by liberal gifts. If times are good and harvests ample the Santo is rewarded with still more gifts, and his aid is sought for another term; but if luck has been bad the Indian repairs to the church at the end of the year, bestows on his holy patron a sound cursing, calls him all the bad names he can think of, and has nothing more to do with him.§

10. A Mexican writer, Andres Iglesias, who enjoyed more than common opportunities to study these practices as they exist in the present generation, describes them as he saw them in the village of Soteapan, a remote hamlet in the State of Vera Cruz, the population of which speak the Mixe language. This is not related to the Nahuatl tongue, but the terms of their magical rites are drawn from Nahuatl words, showing their origin. Every person at birth has assigned to him both a good and a bad genius, the former aiming at his welfare, the latter at his injury. The good genius is known by the Nahuatl term *tonale*, and it is represented in the first bird or animal of any kind which is seen in or near the house immediately after the birth of the infant.

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* *Anales de Cuauhtitlan*, p 31. The translator renders it "palo brujo"

† *Les Anciennes Villes du Nouveau Monde*, pp 146–149, figured on p. 150. On its significance compare Hamy, *Decades Americanae*, pp 74–81.

‡ *The Native Calendar of Central America and Mexico* (Philadelphia, 1893).

§ Eduard Mühlenpfordt, *Mexico*, Bd. 1, s 255.

The most powerful person in the village is the high priest of the native cult. One who died about 1850 was called "the Thunderbolt," and whenever he walked abroad he was preceded by a group of chosen disciples, called by the Nahuatl name *tlatoques*, speakers or attorneys.* His successor, known as "the Greater Thunder," did not maintain this state, but nevertheless claimed to be able to control the seasons and to send or to mitigate destructive storms—claims which, sad to say, brought him to the stocks, but did not interfere with the regular payment of tribute to him by the villagers. He was also a medicine man and master of ceremonies in certain "scandalous orgies, where immodesty shows herself without a veil."

11. Turning to the neighboring province of Oaxaca and its inhabitants, we are instructed on the astrological use of the calendar of the Zapotecs by Father Juan de Cordova, whose *Arte* of their language was published at Mexico in 1578. From what he says its principal, if not its only purpose, was astrological. Each day had its number and was called after some animal, as eagle, snake, deer, rabbit, etc. Every child, male or female, received the name of the day, and also its number, as a surname; its personal name being taken from a fixed series, which differed in the masculine and feminine gender, and which seems to have been derived from the names of the fingers.

From this it appears that among the Zapotecs the personal spirit or *nagual* was fixed by the date of the birth, and not by some later ceremony, although the latter has been asserted by some writers; who, however, seem to have applied without certain knowledge the rites of the Nahuas and other surrounding tribes to the Zapotecs *

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* The word is derived from *tlatoa*, to speak for another, and its usual translation was "chief," as the head man spoke for, and in the name of the gens or tribe.

† The interesting account by Iglesias is printed in the Appendix to the *Diccionario Universal de Geographia y Historia* (Mexico, 1856). Other writers testify to the tenacity with which the Mixes cling to their ancient beliefs. Señor Moro says they continue to be "notorious idolaters," and their actual religion to be "an absurd jumble of their old superstitions with Christian doctrines" (in Orozco y Berra, *Geografía de las Lenguas de Mexico*, p. 178).

Next in importance to the assigning of names, according to Father Cordova, was the employment of the calendar in deciding the propriety of marriages. As the recognized object of marriage was to have sons, the couple appealed to the professional augur to decide this question before the marriage was fixed. He selected as many beans as was the sum of the numbers of the two proponents' names, and, counting them by twos, if one remained over, it meant a son; then counting by threes any remainder also meant sons; by fours the remainder meant either sons or daughters; and by five and six the same; and if there was no remainder by any of these five divisors the marriage would result in no sons and was prohibited.

It is obvious that this method of fortune-telling was most auspicious for the lovers; for I doubt if there is any combination of two numbers below fourteen which is divisible by two, three, four, five and six without remainder in any one instance †

The Zapotecs were one of those nations who voluntarily submitted themselves to the Spaniards, not out of love for the Europeans, but through hatred of the Aztecs, who had conquered them in the preceding century. Their king, Coyopy, and his subjects accepted Christianity. and were generally baptized; but it was the merest formality, and years afterwards Coyopy was detected secretly conducting the heathen ritual of his ancestors with all due pomp. He was arrested, sent to the city of Mexico, deprived of his power and wealth, and soon died; it is charitably supposed, from natural causes. There is no question but that he left successors to the office of pontifex maximus, and that they continued the native religious ceremonies.

12. The sparse notices we have of the astrology of the Mixtecs, neighbors and some think relatives of the Zapotecs, reveal closely similar rites. The name of their king, who opposed Montezuma the First some sixty years before the arrival of Cortez, proves that they made use of the same or a similar calendar in bestowing personal appellations. It is given as *Tres Micos*, Three Monkeys.

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* For instance, J. B. Carriedo, in his *Estudios Historicos del Estado Oaxaqueño* (Oaxaca, 1849), p. 15, says the *nahualt* was a ceremony performed by the native priest, in which the infant was bled from a vein behind the ear, assigned a name, that of a certain day, and a guardian angel or *tona*. These words are pure Nahuatl, and Carriedo, who does not give his authority, probably had none which referred these rites to the Zapotecs.

† Juan de Cordova, *Arte en Lengua Zapoteca*, pp. 16, 202, 203, 213, 216.

Unfortunately, so far as I know, there has not been published, and perhaps there does not exist, an authentic copy of the Mixtec calendar. It was nevertheless reduced to writing in the native tongue after the conquest, and a copy of it was seen by the historian Burgoa in the Mixtec town of Yanhuitlan.* Each day was named from a tree, a plant or an animal, and from them the individual received his names, as Four Lions, Five Roses, etc. (examples given by Herrera). This latter writer adds that the name was assigned by the priests when the child was seven years old (as among the Tzentals), part of the rite being to conduct it to the temple and bore its ears. He refers also to their auguries relating to marriage.† These appear to have been different from among the Zapotecs. It was necessary that the youth should have a name bearing a higher number than that of the maiden, and also "that they should be related;" probably this applied only to certain formal marriages of the rulers which were obliged to be within the same *gens*.

13. I have referred in some detail to the rites and superstitions connected with the Calendar because they are all essential parts of Nagualism, carried on far into Christian times by the priests of this secret cult, as was fully recognized by the Catholic clergy. Wherever this calendar was in use, the Freemasonry of Nagualism extended, and its ritual had constant reference to it. Our fullest information about it does not come from central Mexico, but further south, in the region occupied by the various branches of the Mayan stock, by the ancestors of some one of which, perhaps, this singular calendar, and the symbolism connected with it, were invented.

One of the most important older authorities on this subject is Francisco Nuñez de la Vega, a learned Dominican, who was appointed Bishop of Chiapas and Soconusco in 1687, and who published at Rome, in 1702, a stately folio entitled "*Constitu-*

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* Quoted in Carriedo, ubi supra, p. 17

† *Hist. de las Indias Oc.*, Dec. iii, Lib. iii, cap. 12.

ciones Diœcesanas del Obispado de Chiappa," comprising discussions of the articles of religion and a series of pastoral letters The subject of Nagualism is referred to in many passages, and the ninth Pastoral Letter is devoted to it. As this book is one of extreme rarity, I shall make rather lengthy extracts from it, taking the liberty of condensing the scholastic prolixity of the author, and omitting his professional admonitions to the wicked.

He begins his references to it in several passages of his Introduction or *Preambulo*, in which he makes some interesting statements as to the use to which the natives put their newly-acquired knowledge of writing, while at the same time they had evidently not forgotten the ancient method of recording ideas invented by their ancestors.

The Bishop writes:

> "The Indians of New Spain retain all the errors of their time of heathenism preserved in certain writings in their own languages, explaining by abbreviated characters and by figures painted in a secret cypher * the places, provinces and names of their early rulers, the animals, stars and elements which they worshiped, the ceremonies and sacrifices which they observed, and the years, months and days by which they predicted the fortunes of children at birth, and assign them that which they call the Naguals These writings are known as Repertories or Calendars, and they are also used to discover articles lost or stolen, and to effect cures of diseases Some have a wheel painted in them, like that of Pythagoras, described by the Venerable Bede, others portray a lake surrounded by the Naguals in the form of various animals. Some of the Nagualist Masters claim as their patron and ruler Cuchulchan, and they possessed a certain formula of prayer to him, written in the Populuca tongue (which was called Baha in their time of heathenism), and which has been translated into Mexican.†
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> "Those who are selected to become the masters of these arts are taught from early childhood how to draw and paint these characters, and are obliged to learn by heart the formulas, and the names of the ancient Nagualists, and whatever else is included in these written documents, many of which we have held in our hands, and have heard them explained by such masters whom we had imprisoned for their guilt, and who had afterwards become converted and acknowledged their sins."‡

* So I understand the phrase, "figuras pintadas con cifras enigmaticas."

† *Popoluca* was a term applied to various languages. I suspect the one here referred to was the Mixe. See an article by me, entitled "Chontales and Popolucas; a Study in Mexican Ethnography," in the *Compte Rendu* of the Eighth Session of the Congress of Americanists, p. 554, *seq*.

‡ *Constit. Diocesan.*, p. 19.

The Bishop made up his mind that extreme measures should be taken to eradicate these survivals of the ancient paganism in his diocese, and he therefore promulgated the following order in the year 1692:

> "And because in the provinces of our diocese those Indians who are Nagualists adore their *naguals*, and look upon them as gods, and by their aid believe that they can foretell the future, discover hidden treasures, and fulfill their dishonest desires: we, therefore, prescribe and command that in every town an ecclesiastical prison shall be constructed at the expense of the church, and that it be provided with fetters and stocks (con grillos y cepos), and we confer authority on every priest and curate of a parish to imprison in these gaols whoever is guilty of disrespect toward our Holy Faith, and we enjoin them to treat with especial severity those who teach the doctrines of Nagualism (y con rigor mayor á los dogmatizantes Nagualistas)." *

In spite of these injunctions it is evident that he failed to destroy the seeds of what he esteemed this dangerous heresy in the parishes of his diocese; for his ninth Pastoral Letter, in which he exposes at length the character of Nagualism, is dated from the metropolitan city of Ciudad Real, on May 24, 1698. As much of it is germane to my theme, I translate as follows:

> "There are certain bad Christians of both sexes who do not hesitate to follow the school of the Devil, and to occupy themselves with evil arts, divinations, sorceries, conjuring, enchantments, fortune-telling, and other means to forecast the future.
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> "These are those who in all the provinces of New Spain are known by the name of *Nagualists.* They pretend that the birth of men is regulated by the course and movements of stars and planets, and by observing the time of day and the months in which a child is born, they prognosticate its condition and the events, prosperous or otherwise, of its life; and the worst is that these perverse men have written down their signs and rules, and thus deceive the erring and ignorant.
>
> "These Nagualists practice their arts by means of Repertories and superstitious Calendars, where are represented under their proper names all the Naguals of stars, elements, birds, fishes, brute beasts and dumb animals; with a vain note of days and months, so that they can announce which corresponds to the day of birth of the infant. This is preceded by some diabolical ceremonies, after which they designate the field or other spot, where, after seven years shall have elapsed, the Nagual will appear to ratify the bargain. As the time approaches, they instruct the child to

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* *Constitut. Diocesan*, Titulo vii, pp. 47, 48.

deny God and His Blessed Mother, and warn him to have no fear, and not to make the sign of the cross He is told to embrace his Nagual tenderly, which, by some diabolical art, presents itself in an affectionate manner even though it be a ferocious beast, like a lion or a tiger Thus, with infernal cunning they persuade him that this Nagual is an angel of God, who will look after him and protect him in his after life.

"To such diabolical masters the intelligent Indians apply, to learn from these superstitious Calendars, dictated by the Devil, their own fortunes, and the Naguals which will be assigned to their children, even before they are baptized In most of the Calendars, the seventh sign is the figure of a man and a snake, which they call Cuchulchan. The masters have explained it as a snake with feathers which moves in the water. This sign corresponds with Mexzichuaut, which means Cloudy Serpent, or, of the clouds * The people also consult them in order to work injury on their enemies, taking the lives of many through such devilish artifices, and committing unspeakable atrocities

"Worse even than these are those who wander about as physicians or healers; who are none such, but magicians, enchanters and sorcerers, who, while pretending to cure, kill whom they will. They apply their medicines by blowing on the patient, and by the use of infernal words, learned by heart by those who cannot read or write, and received in writing from their masters by those acquainted with letters. The Master never imparts this instruction to a single disciple, but always to three at a time, so that in the practice of the art it may be difficult to decide which one exerts the magical power They blow on feathers, or sticks, or plants, and place them in the paths where they may be stepped on by those they wish to injure, thus causing chills, fevers, ugly pustules and other diseases, or they introduce into the body by such arts toads, frogs, snakes, centipedes, etc, causing great torments And by these same breathings and magic words they can burn down houses, destroy the growing crops and induce sickness No one of the three disciples is permitted to practice any of these arts without previously informing the other two, and also the Master, by whom the three have been taught.

"We have learned by the confession of certain guilty parties how the Master begins to instruct his disciple First he tells him to abjure God, the saints and the Virgin, not to invoke their names, and to have no fear of them. He then conducts him to the wood, glen, cave or field where the pact with the Devil is concluded, which they call 'the agreement' or 'the word given' (in Tzental *quis*) In some provinces the disciple is laid on an ant-hill, and the Master standing above him calls forth a snake, colored with black, white and red, which is known as 'the ant-mother' (in Tzental *smequis*). † This comes accompanied by the ants and other small snakes of the same kind, which enter at the joints of the fingers, beginning with the left hand, and coming out at the joints of the right hand; and also by the ears and the nose; while the great snake enters the body with a leap and emerges at its posterior vent. Afterwards the disciple meets a dragon vomiting fire, which swallows him entire and ejects him posteriorly. Then the Master declares he may be admitted, and asks him to select the herbs with which he will conjure; the disciple names them, the Master gathers them and delivers them to him, and then teaches him the sacred words.

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* Rather with the Quetzalcoatl of the Nahuas, and the Gucumatz of the Quiches, both of which names mean "Feathered Serpent." Mixcohuatl, the Cloud Serpent, in Mexican mythology, referred to the Thunder-storm.

† In his Tzental Vocabulary, Father Lara does not give this exact form, but in the neighboring dialect of the Cakchiquel Father Ximenes has *quikeho*, to agree together, to enter into an arrangement; the prefix *sme* is the Tzental word for "mother"

These words and ceremonies are substantially the same in all the provinces. The healer enters the house of the invalid, asks about the sickness, lays his hand on the suffering part, and then leaves, promising to return on the day following. At the next visit he brings with him some herbs which he chews or mashes with a little water and applies to the part. Then he repeats the *Pater Noster*, the *Ave*, the *Credo* and the *Salve*, and blows upon the seat of disease, afterwards pronouncing the magical words taught him by his master. He continues blowing in this manner, inhaling and exhaling, repeating under his breath these magical expressions which are powerful to kill or to cure as he chooses, through the compact he has made with the Devil. Finally, so as to deceive the bystanders, he ends with saying in a loud voice, God the Father, God the Son and God the Holy Ghost, Amen.

This physician or healer is called in the towns of some of the provinces *poxta vaneqs*, and the medicine *qsposil*; and everything relating to healing among the Indians to which they apply these terms means also to practice sorcery; and all words derived from *pox* allude to the Nagual; for this in some provinces is called *poxlon*, and in others *patzlan*, and in many *tzihuitzin*, which is something very much feared by the Indians. We have ascertained by the confessions of many who have been reconciled that the Devil at times appears to them in the shape of a ball or globe of fire in the air, with a tail like a comet.*

According to the most ancient traditions of these Indians this idol *poxlon* was one of the most important and venerated they had in the old

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* Father Lara, in his *Vocabulario Tzeltal* MS. (in my possession), gives for medical (medico) *ghpoxil*, for medicine (medicinal cosa) *pox, zpoxtael pox*; for physician (medico) *ghpoxta vaneqs* (the form *vaneqs*, person, is also correct). The Tzendal *pox* (pronounced *posh*) is another form of the Quiche-Cakchiquel *pàz*, a word which Father Ximenes, in his *Vocabulario Cakchiquel* MS. (in my possession), gives in the compound *paz nawal*, with the meaning enchanter, wizard. Both these, I take it, are derived from the Maya *pux*, which means to blow the dust, etc., off of something (soplar el polvo de la ropa ú otras cosas. *Dicc. de la Lengua Maya del Convento de Motul*, MS. The dictionary edited by Pio Perez does not give this meaning). The act of blowing was the essential feature in the treatment of these medicine men. It symbolized the transfer and exercise of spiritual power. When Votan built his underground shrine he did it *á soplos*, by blowing (Nuñez de la Vega, *Constitut. Diœcesan.*, p. 10). The natives did not regard the comet's tail as behind it, but in front of it, blown from its mouth. The Nahuatl word in the text *tzihuitzin* is the Pipil form of *xihuitzin*, the reverential of *xihuitl*, which means a leaf, a season, a year or a comet. Apparently it refers to the Nahuatl divinity *Xiuhtecutli*, described by Sahagun, *Historia de Nueva España*, Lib. I, cap. 13, as god of fire, etc.

> times, and the Tzentals revered it so much that they preserved it innumerable years painted on a tablet in the above figure. Even after they were converted to the faith they hung it behind a beam in the church of the town of Oxchuc, accompanied by an image of their god Hicalahau, having a ferocious black face with the members of a man,* along with five owls and vultures. By divine interposition we discovered these on our second visit there in 1687, and had no little difficulty in getting them down, we reciting the creed and the Indians constantly spitting as they executed our orders. These objects were publicly burned in the plaza.
>
> In other parts they reverence the bones of the earlier Nagualists, preserving them in caves, where they adorn them with flowers and burn copal before them. We have discovered some of these and burned them, hoping to root out and put a stop to such evil ceremonies of the infernal sect of the Nagualists.
>
> At present all are not so subject to the promptings of the Devil as formerly, but there are still some so closely allied to him that they transform themselves into tigers, lions, bulls, flashes of light and globes of fire. We can say from the declaration and solemn confession of some penitents that it is proved that the Devil had carnal relations with them, both as incubus and succubus, approaching them in the form of their Nagual; and there was one woman who remained in the forest a week with the demon in the form of her Nagual, acting toward him as does an infatuated woman toward her lover (como pudiera con su proprio amigo una muger amancebada). As a punishment for such horrible crimes our Lord has permitted that they lose their life as soon as their Nagual is killed, and that they bear on their own bodies the wound or mark of the blow which killed it, as the curas of Chamula, Copainala and other places have assured us.
>
> The devilish seed of this Nagualism has rooted itself in the very flesh and blood of these Indians. It perseveres in their hearts through the instructions of the masters of the sect, and there is scarcely a town in these provinces in which it has not been introduced. It is a superstitious idolatry, full of monstrous incests, sodomies and detestable bestialities.

Such are the words of the Bishop of Chiapas. We learn from his thoroughly instructed and unimpeachable testimony that at the beginning of the eighteenth century Nagualism was a widespread and active institution among the Indians of southern Mexico, that it was taught and practiced by professors who were so much feared and respected that, as he tells us in another passage, they were called "masters of the towns,"† that they gave systematic instruction to disciples in classes of three, all of whom were bound together by pledges of mutual information and assistance; that a fundamental principle of the organization and an indispensable step in the initiation into its mysteries was the abjuration of the Christian religion and an undying hatred to its teachers and all others of the race of the white oppressors; and that when they made use of Christian phrases or ceremonies it was either in derision or out of hypocrisy, the better to conceal their real sentiments.

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* *Hicalahau* for *ical ahau*, Black King, one of the Tzental divinities who will be referred to on a later page.

† "Maestros de los pueblos." *Constitut. Diocesan.*, p. 108.

There are a number of other witnesses from the seventeenth century that may be summoned to strengthen this testimony, if it needs it.

14. In the *History of Guatemala*, written about 1690 by Francisco Antonio Fuentes y Guzman, the author gives some information about a sorcerer of this school who was arrested in Totonicapan and with whom the historian had something to do as *corregidor*.

The redoubtable magician was a little old man, *viejezuelo*, and when caught had in his possession a document giving the days of the year according to the European calendar with the Nagual, which belonged to each one. That for January is alone given by our writer, but it is probable that the other months merely repeated the naguals corresponding to the numbers. It ran as follows:

Nagual Calendar for January.

1	Lion.
2	Snake.
3	Stone.
4	Alligator.
5	Ceiba tree.
6	The quetzal (a bird).
7	A stick.
8	Rabbit.
9	A rope.
10	Leaf.
11	Deer.
12	Guacamayo (parrot).
13	Flower.
14	Toad.
15	Caterpillar.
16	A chip.
17	Arrow.
18	Broom.
19	Jaguar.
20	Corn husk.
21	A flute.
22	Green stone.
23	Crow.
24	Fire.
25	A pheasant.
26	A reed.
27	Opossum.
28	Huracan (the thunder storm).
29	The vulture.
30	Hawk.
31	Bat.

When the sorcerer was examined as to the manner of assigning the proper nagual to a child, he gave the following account: Having been informed of its day of birth, he in due time called at the residence of the parents and told the mother to bring the child into the field behind the house. Having there invoked the demon, the *nagual* of the child would appear under the form of the animal or object set opposite its birthday in the calendar; a serpent were it born on the 21 of January, a flower were it on the 13th, fire were it on the 24th, and so on. The sorcerer then addressed certain prayers to the *nagual* to protect the little one, and told the mother to take it daily to the same spot, where its *nagual* would appear to it, and would finally accompany it through all its life. Some, but not all, obtained the power of transforming themselves into the *nagual*; and the author declares that though he could not cite such a case from his own experience, his father knew of several, and reliable priests, *religiosos de fé*, had told him enough examples to fill volumes.*

The tribes to which this author refers were the Cakchiquels and Quiches, who spoke practically the same tongue. An examination of some of the old dictionaries prepared by the early missionaries furnishes further and interesting information about this obscure subject.

In the Cakchiquel language of Guatemala the word *naual* was applied both to the magician himself, to his necromantic art, and to the demonic agency which taught and protected him. This is shown by the following explanation, which I quote from Father Coto's *Vocabulario de la Lengua Cakchiquel*, 1651, a manuscript in the library of the American Philosophical Society:

> "*Magic* or *Necromancy*, *pus* or *naual*; and they were accustomed to call their magicians or sorcerers by the same terms. It was a kind of magic which they invoked in order to transform themselves into eagles, lions, tigers, etc. Thus they said, *ru pus ru naual pedro la cot balam*, 'Peter's power, his *naual*, is a lion, a tiger.' They also applied the words *pus* and *naual* to certain trees, rocks and other inanimate objects, whence the Devil used to speak to them, and likewise to the idols which they worshiped; as *gaslic che, gaslic abah, huyu, k'o ru naual*, 'The life of the tree, the life of the stone, of the hill, is its *naual*,' etc., because they believed there was life in these objects. They used to have armies and

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* *Historia de Guatemala ó Recordacion Florida*, Tom. ii, p. 44, seq.

soldiery to guard their lands, and the captains, as well as many who were not captains, had their *naualles*. They called the captain *ru g alche, rohobachi ti ru gih ru poc b ru gh amay a ghiy ti be chi naualil* [he works magic with his shield, his lance and his arrows].

'To practice such magical arts, *tin naualih* (I practice magic), an active verb. They use it for instance when a man asks his wife for something to eat or drink and she has nothing, owing to his negligence, she will say, Where do you suppose I can get what you want? Do you expect me to perform miracles—*xa pe ti tin naualih*—that they shall come to my hands? So when one is asked to lend or give something which he has not, he will exclaim, *Tin naualih pe ri puvik*, etc. (Can I perform miracles,' etc.)

It also signifies to pretend something, concealing the truth, as *xa ru naualim ara neh chu g ux ri tzih tan tu bijh pedro*, Peter is feigning this which he is saying. They are also accustomed to apply this word to the power which the priests exert (in the sacraments, etc.)

A long and foolish account of the witchcraft supposed to be practiced among the Pokonchis of Guatemala, also a tribe of Mayan stock, is given by the Englishman Thomas Gage, who was cura of a parish among them about 1630 and afterwards returned to England and Protestantism. He described, at wearisome length, the supposed metamorphosis of two chiefs of neighboring tribes, the one into a lion, the other into a tiger, and the mortal combat in which they engaged, resulting in the death of one to whom Gage administered absolution. No doubt he had been worsted in a personal encounter with his old enemy, and, being a man of eighty years, had not the vigor to recover. The account is of interest only as proving that the same superstitions at that time prevailed among the Pokonchis as in other portions of Guatemala.*

15. A really mighty nagualist was not confined to a single transformation. He could take on many and varied figures. One such is described in the sacred books of the Quiches of Guatemala, that document known by the name of the Popol Vuh, or National Book. The passage is in reference to one of their great kings and powerful magicians, Gucumatz by name. It says:

"Truly he was a wonderful king. Every seven days he ascended to the sky, and every seven days he followed the path to the abode of the dead, every seven days he put on the nature of a serpent, and then he became truly a serpent, every seven days he assumed the nature of an eagle, and then he became truly an eagle, then of a tiger and he became truly a tiger, then of coagulated blood, and he was nothing else than coagulated blood."*

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* Gage, *A New Survey of the West Indies*, p. 388, seq. (4th Ed.)

It may be said that such passages refer metaphorically to the versatility of his character, but even if this is so, the metaphors are drawn from the universal belief in Nagualism which then prevailed, and they do not express it too strongly.

16. Among the Maya tribes of Yucatan and Guatemala we have testimony to the continuance to this day of these beliefs Father Bartolomé de Baeza, cura of Yaxcaba in the first half of this century, reports that an old man, in his dying confession, declared that by diabolical art he had transformed himself into an animal, doubtless his *nagual*; and a young girl of some twelve years confessed that she had been transformed into a bird by the witches, and in one of her nocturnal flights had rested on the roof of the very house in which the good priest resided, which was some two leagues from her home. He wisely suggests that, perhaps, listening to some tale of sorcery, she had had a vivid dream, in which she seemed to take this flight. It is obvious, however, from his account, as well as from other sources, that the belief of the transformation into lower animals was and is one familiar to the superstitions of the Mayas † The natives still continue to propitiate the ancient gods of the harvest, at the beginning of the season assembling at a ceremony called by the Spaniards the *misa milpera*, or "field mass," and by themselves *tich*, "the stretching out of the hands"

The German traveler, Dr. Scherzer, when he visited, in 1854, the remote hamlet of Istlavacan, in Guatemala, peopled by Quiché Indians, discovered that they had preserved in this respect the usages of their ancestors almost wholly unaffected by the teachings of their various Christian curates The "Master" still assigned the *naguals* to the new born infants, copal was burned to their ancient gods in remote caves, and formulas of invocation were taught by the veteran nagualists to their neophytes.*

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* *Le Popol Vuh, ou Livre Sacré des Quichés*, p. 315 (Ed Brasseur, Paris, 1861) In the Quiche myths, Gucumatz is the analogue of Quetzalcoatl in Aztec legend Both name mean the same, "Feathered Serpent."

† Baeza's article is printed in the *Registro Yucateco*, Vol I, p 165, *seq.*

These *Zahoris*,† as they are generally called in the Spanish of Central America, possessed many other mysterious arts besides that of such metamorphoses and of forecasting the future. They could make themselves invisible and walk unseen among their enemies; they could in a moment transport themselves to distant places, and as quickly returning report what they had witnessed; they could create before the eyes of the spectator a river, a tree, a house or an animal where none such existed; they could cut open their own stomach, or lop a limb from another person and immediately heal the wound or restore the severed member to its place; they could pierce themselves with knives and not bleed or handle venomous serpents and not be bitten; they could cause mysterious sounds in the air, and fascinate animals and persons by their steady gaze; they could call visible and invisible spirits and the spirits would come.

Among the native population of the State of Vera Cruz and elsewhere in southern Mexico these mysterious personages go by the name *padrinos*, godfathers, and are looked upon with a mixture of fear and respect. They are believed by the Indians to be able to cause sickness and domestic calamities and are pronounced by intelligent whites to present "a combination of rascality, duplicity and trickery."‡

17. The details of the ceremonies and doctrines of Nagualism have never been fully revealed; but from isolated occurrences and partial confessions it is clear that its adherents formed a coherent association extending over most of southern

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* "Wird ein Kind im Dorfe geboren, so erhalt der heidnische Götzenpriester von diesem Ereignisse viel eher Kunde als der katholische Pfarrer. Erst wenn dem neuen Weltbürger durch den Ajquig das Horoskop gestellt, der Name irgend eines Thieres beigelegt, Misisal (das citrongelbe Harz des Rhus copallinum) verbrannt, ein Lieblingsgötze angerufen und noch viele andere abergläubische Mysterien verrichtet worden sind, wird das Kind nach dem Pfarrhause zur christlichen Taufe getragen. Das Thier dessen Name dem Kinde kurz nach seiner Geburt vom Sonnenpriester beigelegt wird, gilt gewöhnlich auch als sein Schutzgeist (*nagual*) fürs ganze Leben." Dr. Karl Scherzer, *Die Indianer von Santa Catalina Istlavacan*, p. 11, Wien, 1856.

† The word *zahori*, of Arabic origin, is thus explained in the Spanish and English dictionary of Delpino (London, 1763): "So they call in Spain an impostor who pretends to see into the bowels of the earth, through stone walls, or into a man's body." Dr. Stoll says the Guatemala Indians speak of their diviners, the *Ah Kih*, as *zahorin*. *Guatemala*, s. 229.

‡ Emeterio Pineda, *Descripcion Geografica de Chiapas y Soconusco*, p. 22 (Mexico, 1845).

Mexico and Guatemala which everywhere was inspired by two ruling sentiments—detestation of the Spaniards and hatred of the Christian religion.

In their eyes the latter was but a cloak for the exactions, massacres and oppressions executed by the former. To them the sacraments of the Church were the outward signs of their own subjugation and misery. They revolted against these rites in open hatred, or received them with secret repugnance and contempt. In the Mexican figurative manuscripts composed after the conquest the rite of baptism is constantly depicted as the symbol of religious persecution. Says a sympathetic student of this subject:

> The act of baptism is always inserted in their records of battles and massacres. Everywhere it conveys the same idea—making evident to the reader that the pretext for all the military expeditions of the Spaniards was the enforced conversion to Christianity of the natives, a pretext on which the Spaniards seized in order to possess themselves of the land and its treasure, to rob the Indians of their wives and daughters, to enslave them and to spill their blood without remorse or remission. One of these documents dated in 1526 adds a trait of savage irony. A Spanish soldier is represented dragging a fugitive Indian from a lake by a lasso around his neck, while on the shore stands a monk ready to baptize the recreant on his arrival!*

No wonder that the priests of the dark ritual of Nagualism for centuries after the conquest sought to annul the effects of the hated Christian sacraments by counteracting ceremonies of their own, as we are told they did by the historian Torquemada, writing from his own point of view in these words:

> "The Father of Lies had his ministers who aided him, magicians and sorcerers, who went about from town to town persuading the simple people to that which the Enemy of Light desired. Those who believed their deceits, and had been baptized, were washed on the head and breast by these sorcerers, who assured them that this would remove the effects of the chrism and the holy oils. I myself knew an instance where a person of prominence, who resided not far from the City of Mexico, was dying, and had received extreme unction, and when the priest had departed one of these diabolical ceremonialists entered and washed all the parts which had been anointed by the holy oil with the intention to destroy its power."†

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* Madier de Montjau, Manuscrits Figuratifs de l'Ancien Mexique, in *Archives de la Société Américaine de France*, 1875, p. 215.

† Torquemada, *Monarquia Indiana*, Lib. xv, cap. 16.

Similar instances are recorded by Jacinto de la Serna. He adds that not only did the Masters prescribe sacrifices to the Fire in order to annul the effects of extreme unction, but they delighted to caricature the Eucharist, dividing among their congregation a narcotic yellow mushroom for the bread and the inebriating pulque for the wine. Sometimes they adroitly concealed in the pyx alongside the holy wafer some little idol of their own, so that they really followed their own superstitions while seemingly adoring the Host. They assigned a purely pagan sense to the sacred formula "Father, Son and Holy Ghost," understanding it to be "Fire, Earth and Air," or the like.*

Whoever or whatever was an enemy to that religion so brutally forced upon these miserable creatures was to them an ally and a friend. Nunez de la Vega tells us that he found written formulas among them reading: "O Brother Antichrist, Brother Antichrist, Brother Antichrist, come to our aid!"—pathetic and desperate appeal of a wretched race ground to earth under the iron heels of a religious and military despotism.†

18. The association embraced various tribes and its members were classified under different degrees. The initiation into these was by solemn and often painful ceremonies. Local sodalities or brotherhoods were organized after the manner of those usual in the Roman Church, but instead of being named after St. John or the Virgin Mary, they were dedicated to Judas Iscariot or Pontius Pilate out of derision and hatred of the teachings of the priests, or to the Devil or Antichrist, who were looked upon as powerful divinities in opposition to the Church.‡

There were certain recognized centres of the association, near which its most important dignitaries resided and where their secret councils and most imposing ceremonies were held. One of these was Zamayac, in the province of Suchiltepec, a second near Huehuetan, Soconusco, a third at Totonicapan, Guatemila, a fourth at Cancuc, Chiapas; a fifth at Teozapotlan, Oaxaca, and a few others may be surmised.

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* De la Serna, *Manual de Ministros*, pp. 20, 21, 42, 162. The mushroom referred to was the *quauhnanacatl*, probably the same as the *teyhuintli* of Hernandez, *Hist. Nat. Nov. Hispan.*, Tom. ii, p. 358, who says that it is not dangerous to life, but disturbs the mind, inciting to laughter and intoxication.

† Actual slavery of the Indians in Mexico continued as late as the middle of the seventeenth century. See Cavo, *Tres Siglos de Mexico*, etc., Tom. ii, p. 11.

‡ Brasseur, *Hist. des Nations Civilisées de Mexique*, Tom. iv, p. 822.

The high priest who resided at each of these centres exercised control over all the nagualistic teachers and practitioners in an extensive district. On the occasion of an official inquiry by the Spanish authorities it was ascertained that the high priest of Zamayac included under his rule nearly one thousand sub-priests,* and no doubt others of his rank were not less potent.

The unity between the members of the association over an indefinitely wide area was perfectly well known to the Spanish priests and civil authorities. The ceremonies, formulas and methods of procedure were everywhere identical or alike. This itself was justly regarded as a proof of the secret intelligence which existed among the members of this cabalistic guild.†

To a certain extent and at least in some localities, as Chiapas and Guatemala, the priesthood of Nagualism was hereditary in particular families. This is especially stated by the historian Ordoñez y Aguiar, who had exceptional opportunities for acquainting himself with the facts.‡

A traveler of the first decade of this century, who has left us a number of curious details of the superstitions of the Christianized Indians in Mexico of that day, Benito Maria de Moxo, informs us that he had discovered the existence of different grades in the native soothsayers and medicine men, and that all in a given locality recognized the supremacy of one whom they referred to as "the little old man," *El Viejito*. But he was unable to ascertain by what superior traits or rights he obtained this distinction.§

According to some authorities the highest grade of these native hierophants bore among the Nahuas the symbolic name of "flower-weavers," Xochimilca, probably from the skill they had to deceive the senses by strange and pleasant visions.* In the south they were spoken of as "guardians," which may have been derived from the classes of priests so called in the Zapotec religion.†

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* *Informe del teniente general D. Juan de Barba Figueroa, corregidor de la Provincia de Suchitepeques*, quoted by Brasseur.

† Jacinto de la Serna says: "Los maestros de estas ceremonias son todos unos, y lo que sucede en esta cordillera en todas sucede." *Manual de Ministros*, p. 2. Speaking of the methods of the nagualists of Chiapas, Bishop Nuñez de la Vega writes: "Concuerdan los mas modernos con los mas antiguos que se practicaban en Mexico." *Constituciones Diocesanas*, p. 134.

‡ He observes that there were "familias de los tales sabios en las quales en manera de patrimonio se heredaban, succediendo los hijos á los padres, y principalmente su abominable secta de Nagualismo." *Historia del Cielo y de la Tierra*, MS., p. 7. Ordoñez advances various erudite reasons for believing that Nagualism is a religious belief whose theory and rites were brought from Carthage by Punic navigators in ancient times.

§ Maria de Moxó, *Cartas Mejicanas*, p. 270 (Genova, n. d.).

19. It will be seen from the above that Nagualism, beginning in an ancient superstition dating back to the time of primitive barbarism, became after the Conquest a potent factor in the political and social development of the peoples among whom it existed; that it was the source from which was drawn and the means by which was sustained the race-hatred of the native American towards his foreign conquerors, smouldering for centuries, now and then breaking out in furious revolt and civil war.

There is strong reason to suspect its power where for obvious reasons it has not been demonstrated. It has always been a mystery and a matter of surprise to the historians of Yucatan how rapidly spread the plans of the insurrection which secured lasting independence for the natives after these plans had been agreed upon by the two chiefs Antonio Ay and Cecilio Chi, at the remote rancho of Xihum in July, 1847. Such unanimity of action could only have been possible through the aid of a powerful, well-disciplined and widespread secret organization. There can scarcely be a doubt they were the chiefs or masters of the redoubtable order of Nagualism in the Peninsula.‡

There is no question that such was the case with the brief and bloody revolt of the Mayas in 1761. It suddenly broke out in a number of villages near Valladolid, Yucatan, headed by a full-blood native, Jacinto Can Ek; but some of the participants afterwards confessed that it was the outcome of a conspiracy which had been preparing for a year.

When the appointed day arrived Jacinto boldly announced himself as the high priest of the fraternity of sorcerers, a master and teacher of magic and the lineal successor of the famous ancient prophet Chilan Balam, "whose words cannot fail." In a stirring appeal he urged his fellow countrymen to attack the Spaniards without fear of consequences.

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* "*Xochimilca*, que assi llamavan á los mui sabios encantadores." Torquemada, *Monarquia Indiana*, Lib. xv, cap. 1.

† In Nahuatl *tlapixqui*, a guardian or watchman. The Zapotec priesthood was divided into the *huijatoos*, greater guardians, and their inferiors the *copavitoos*, guardians of the gods. (Carriedo, *Estudios Historicos*, p. 91.)

‡ See Eligio Ancona, *Historia de Yucatan*, Tom. iv, cap. 1 (Mérida, 1880).

> "Be not afraid," he exclaimed, "of their cannons and their forts, for among the many to whom I have taught the arts of magic (el arte de brujeria) there are fifteen chosen ones, marvelous experts, who by their mystic power will enter the fortress, slay the sentinels and throw open the gates to our warriors. I shall take the leaves of the sacred tree, and folding them into trumpets, I shall call to the four winds of heaven, and a multitude of fighting men will hasten to our aid."*

Saying this, he took a sheet of paper, held it up to show that it was blank, folded it for a moment, and then spread it out covered with writing! This deft trick convinced his simple-minded hearers of the truth of his claims, and they rushed to arms. He led them clothed in the robe of the Virgin and with her crown on his head. But neither their enthusiasm nor their leader's art magic availed, and soon Jacinto and his followers fell victims to the stake and the gallows. After their death the dance of "the tiger," or of Chic Mool—the "ghost dance" of the Mayas—was prohibited, and the use of the sacred drum—the favorite instrument of the native priests—was forbidden.†

In fact, wherever we have any full accounts of the revolts against the Spanish domination during the three centuries of its existence in New Spain, we can manifestly trace the guiding fingers of the powerful though hidden hand of Nagualism. An earlier revolt of the Mayas in Yucatan occurred in 1585. It was led by Andres Chi, a full-blood Indian, and a descendant of the ancient royal house of the Cocomes. He also announced himself as a priest of the ancient faith, a prophet and a worker of miracles, sent to instruct his own people in a new religion and to give them an independent political existence. Seized by the Spaniards he was charged with idolatry, sorcery and disturbing the peace, and was ignominiously hanged.*

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* The mention of the fifteen (5 × 3) chosen disciples indicates that the same system of initiating by triplets prevailed in Yucatan as in Chiapas (see above, p. 27). The sacred tree is not named, but presumably it was the ceiba, to which I refer elsewhere. The address of Jacinto was obtained from those present, and is given at length by the Jesuit Martin del Puerto, in his *Relacion hecha al Cabildo Eclesiastico por el preposito de la Compañia de Jesus acerca de la muerte de Jacinto Can Ek y socios*, Dec. 26, 1761. It is published with other documents relating to this revolt in the Appendix to the *Diccionario Universal*, edited by Orosco y Berra, Mexico, 1856. On the prophecies of Chilan Balam see my *Essays of an Americanist*, pp. 255–273 (Philadelphia, 1890).

† Eligio Ancona, *Hist. de Yucatan*, Tom. II, p. 453.

Not less definitely inspired by the same ideas was the Mixe Indian known as "Don Pascual," who led the revolt of the Tehuantepec tribes in 1661. He sent out his summons to the "thirteen governors of the Zapotecs and Chontales" to come to his aid, and the insurrection threatened to assume formidable proportions, prevented only by bringing to bear upon the natives the whole power of the Roman Church through the Bishop of Oaxaca, Cuevas Davalos.†

Nearly the same locality had been the scene of the revolt of the Zapotecs in 1550, when they were led by a native priest who claimed to be an incarnation of the old god Quetzalcoatl, the patron deity of the nagualists.‡

In the city of Mexico itself, in the year 1692, there was a violent outbreak of the natives, when they destroyed three million dollars worth of property. Doubtless this was partly attributable to the scarcity of food which prevailed; but that the authorities traced it also to some secret ceremonials is evident from the law which was immediately passed forbidding the Indians to wear the *piochtli*, or scalp lock, a portion of the hair preserved from birth as part of the genethliac rituals,§ and the especial enactments against the *octli*.

As for the revolt of the Tzentals of Chiapas in 1712, it was clearly and confessedly under the leadership of the nagualistic priesthood, as I shall indicate on a later page.

The history of the native American race under the Spanish power in North America has never yet been written with the slightest approach to thoroughness. He who properly qualifies himself for that task will certainly reach the conclusion expressed a number of years ago by the eminent American antiquary and historian, Mr. E. G. Squier, in these words:

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* See Pedro Sanchez de Aguilar, *Informe contra Idolorum Cultores en Yucatan* (Madrid, 1639); Eligio Ancona, *Historia de Yucatan*, Tom. ii, pp. 128, 129.

† The chief authority on this revolt is Juan de Torres Castillo, *Relacion de lo Sucedido en las Provincias de Nexapa, Iztepex y la Villa Alta* (Mexico, 1662). See also Cavo, *Los Tres Siglos de Mexico durante el Gobierno Español*, Tom. ii, p. 41; and a pamphlet by Christoval Manso de Contreras, *Relacion cierta y verdadera de lo que ha sucedido en esta Provincia de Tehuantepec*, etc. (printed at Mexico, 1661), which I know only through the notes of Dr. Berendt. Mr. H. H. Bancroft, in his very meagre account of this event, mistakingly insists that it took place in 1660. *History of Mexico*, Vol. iii, p. 161.

‡ See Brasseur de Bourbourg, *Histoire des Nations Civilisées du Mexique*, Tom. iv, 824.

§ Cavo, *Los Tres Siglos*, etc., Tom. ii, p. 8. On the use and significance of the *piochtli* we have some information in Vetancourt, *Teatro Mexicano*, Tom. ii, p. 464, and de la Serna, *Manual de Ministros*, pp. 166, 167. It was the badge of a certain order of the native priesthood.

> Among the ruling and priestly classes of the semi-civilized nations of America there has always existed a mysterious and powerful secret organization, which all the disasters to which they have been subjected have not destroyed. It is to its present existence that we may attribute those simultaneous movements of the aborigines of Mexico and Central America which have more than once threatened the complete subversion of the Spanish power.*

That mysterious bond, that secret organization, is *Nagualism*.

20. A remarkable feature in this mysterious society was the exalted position it assigned to Women. Not only were they admitted to the most esoteric degrees, but in repeated instances they occupied the very highest posts in the organization. According to the traditions of the Tzentals and Pipils of Chiapas, when their national hero Votan constructed by the breath of his mouth his darkened shrine at Tlazoaloyan, in Soconusco, he deposited in it the sacred books and holy relics, and constituted a college of venerable sages to be its guardians; but placed them all in subjection to a high priestess, whose powers were absolute.†

The veracious Pascual de Andagoya asserts from his own knowledge that some of these female adepts had attained the rare and peculiar power of being in two places at once, as much as a league and a half apart;‡ and the repeated references to them in the Spanish writings of the sixteenth and seventeenth centuries confirm the dread in which they were held and the extensive influence they were known to control. In the sacraments of Nagualism Woman was the primate and hierophant.

21. This was a lineal inheritance from pre-Columbian times. In many native American legends, as in others from the old world, some powerful enchantress is remembered as the founder of the State, mistress of men through the potency of her magic powers.

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* *Adventures on the Mosquito Shore*, by S. A. Bard, pseudonym of Mr. Squier, p. 258 (New York, 1855).

† Nuñez de la Vega, *Constituciones Diocesanas*, p. 10, and comp. Brasseur de Bourbourg, *Hist. des Nat. Civ. de Mexique*, Tom. i, p. 74.

‡ Herrera, *Hist. de las Indias Occidentales*, Dec. ii, Lib. iii, cap. 5.

Such, among the Aztecs, was the sorceress who built the city of Mallinalco, on the road from Mexico to Michoacan, famous even after the conquest for the skill of its magicians, who claimed descent from her.* Such in Honduras was Coamizagual, queen of Cerquin, versed in all occult science, who died not, but at the close of her earthly career rose to heaven in the form of a beautiful bird, amid the roll of thunder and the flash of lightning.†

According to an author intimately familiar with the Mexican nagualists, the art they claimed to possess of transforming themselves into the lower animals was taught their predecessors by a woman, a native Circe, a mighty enchantress, whose usual name was Quilaztli (the etymology of which is unknown), but who bore also four others representing her four metamorphoses: Cohuacihuatl, the Serpent Woman; Quauhcihuatl, the Eagle Woman; Yaocihuatl, the Warrior Woman, and Tzitzimecihuatl, the Specter Woman.‡

The powers of these queens of magic extended widely among their sex. We read in the chronicles of ancient Mexico that when Nezahualpilli, the king, oppressed the tribes of the coast, the *tierra caliente*, they sent against him not their warriors, but their witches. These cast upon him their fatal spells, so that when he walked forth from his palace blood burst from his mouth and he fell prone and dead.§

In Guatemala, as in ancient Delphos, the gods were believed to speak through the mouths of these inspired seeresses, and at the celebration of victories they enjoyed a privilege so strange and horrible that I quote it from the old manuscript before me without venturing a translation:

> Despues de sacrificar los antiguos algun hombre despedaçandolo, si era de los que avian cogido en guerra, dicen que guardaban el

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* Acosta, *Hist. Nat. y Moral de las Indias*, Lib. vii, cap. 5.

† The story is given in Herrera, *Hist. de las Indias*, Dec. iv, Lib. viii, cap. 4. The name Coamizagual is translated in the account as "Flying Tigress." I cannot assign it this sense in any dialect.

‡ Jacinto de la Serna, *Manual de Ministros*, p. 188. Sahagun identifies Quilaztli with Tonantzin, the common mother of mankind and goddess of childbirth (*Hist. de Nueva España*, Lib. i, cap. 6; Lib. vi, cap. 27). Further particulars of her are related by Torquemada, *Monarquia Indiana*, Lib. ii, cap. The *tzitzimime* were mysterious elemental powers which the Nahuas believed were destined finally to destroy the present world (Sahagun, l. c., Lib. vi, cap. 8). The word means "flying haired" (Serna).

§ Torquemada, *Monarquia Indiana*, Lib. ii, cap. 62.

miembro genital y los testiculos del tal sacrificado, y estos los daban a una vieja que tenian por profeta, para que los comiese y le pidiese rogase a su idolo les diese mas captivos."*

When Captain Pedro de Alvarado, in the year 1521, was marching upon Quetzaltenango, in Guatemala, just such a fearful old witch took her stand at the summit of the pass, with her familiar in the shape of a dog, and by spells and nagualistic incantations† undertook to prevent his approach.‡

As in the earliest, so in the latest accounts. The last revolt of the Indians of Chiapas occurred among the Tzotzils in 1869. The cause of it was the seizure and imprisonment by the Spanish authorities of a "mystical woman," known to the whites as Santa Rosa, who, together with one of their *ahau*, or chieftains, had been suspected of fomenting sedition. The natives marched thousands strong against the city of San Cristobal, where the prisoners were, and secured their liberation; but their leader, Ignacio Galindo, was entrapped and shot by the Spaniards, and the mutiny was soon quelled.‡

22. But perhaps the most striking instance is that recorded in the history of the insurrection of the Tzentals of Chiapas in 1713. They were led by an Indian girl, a native Joan of Arc, fired by like enthusiasm to drive from her country the hated foreign oppressors and to destroy every vestige of their presence. She was scarcely twenty years old, and was known to the Spaniards as Maria Candelaria. She was the leader of what most historians call a religious sect, but what Ordonez y Aguiar, himself a native of Chiapas, recognizes as the powerful secret association of Nagualism, determined on the extirpation of the white race. He estimates that in Chiapas alone there were nearly seventy thousand natives under her orders—doubtless an exaggeration—and asserts that the conspiracy extended far into the neighboring tribes who had been ordered to await the result of the effort in Chiapas.

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* Fr. Tomas Coto, *Diccionario de la Lengua Cakchiquel*, MS., s. v. *Sacrificar*, in the Library of the American Philosophical Society at Philadelphia.

† "Trataron de valerse del arte de los encantos y *nagualismos*," are the words of the author Fuentes y Guzman, in his *Recordacion Florida*, Tom. I, p. 50. In the account of Bernal Diaz it reads as if this witch and her dog had both been sacrificed, but Fuentes is clear in his statement, and had other documents at hand.

‡ Teobert Maler, "Mémoire sur l'Etat de Chiapas," in the *Revue d'Ethnographie*, Tom. III, pp. 309-311. This writer also gives some valuable facts about the Indian insurrection in the Sierra de Alicia in 1873.

Her authority was absolute and she was merciless in requiring obedience to it. The disobedient were flayed alive or roasted over a slow fire. She and all her followers took particular pleasure in manifesting their hatred and contempt for the religion of their oppressors. They defiled the sacred vessels of the churches, imitated with buffoonery the ceremonies of the mass which she herself performed, and stoned to death the priests whom they caught.

Of course her attempt against the power of Spain was hopeless. It failed after a bitter and protracted conquest characterized by the utmost inhumanity on both sides. But when her followers were scattered and killed, when the victorious whites had again in their hands all the power and resources of the country, not their most diligent search, nor the temptation of any reward enabled them to capture Maria Candelaria, the heroine of the bloody drama. With a few trusty followers she escaped to the forest, and was never again heard of.*

More unfortunate were her friends and lieutenants, the priestesses of Guistiupan and Yajalon, who had valiantly seconded Maria in her patriotic endeavors. Seized by the Spaniards they met the fate which we can easily imagine, though the historian has mercifully thrown a veil on its details.†

23. Of just such a youthful prophetess did Mr. E. G. Squier hear during his travels in Central America, a "*sukia* woman," as she was called by the coast Indians, one who lived alone mid the ruins of an old Maya temple, a sorceress of twenty years, loved and feared, holding death and life in her hands.‡ Perhaps his account is somewhat fanciful; it is so, indeed; but it is grounded on the unshaken beliefs and ancient traditions of the natives of those climes, and on customs well known to those who reside there.

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* The long account given by Mr. H. H. Bancroft of this insurrection is a travesty of the situation drawn from utterly prejudiced Spanish sources, of course utterly out of sympathy with the motives which prompted the native actors. See his *History of the Pacific States*, Vol. II, p. 698, *sqq.* Ordoñez y Aguilar, who lived on the spot within a generation of the occurrences, recognizes in Maria Candelaria (whose true name Bancroft does not give) the real head of the rebellion, "quien ordenaba los ardides del motin," . . . "de lo que principalmente trataban las leyes fundamentales de su secta, era de que no quedase rastro alguno de que los Europeos hubiesen pisado este suelo." His account is in his unpublished work *Historia del Cielo y de la Tierra*, written at Guatemala about 1780. Juarros, speaking of their rites, says of them: "Apostando de la fé, profanando los vasos sagrados y ofreciendo sacrilegos cultos á una indizuela." *Historia de la Ciudad de Guatemala*, Tom. I, p. 17.

† Bancroft, ubi suprà, p. 705, note. One was hanged, whom Garcia Pelaez calls "una india bruja." *Memorias para la Historia de Guatemala*, Tom. II, p. 153.

‡ Squier, ubi suprà, passim.

The late distinguished Americanist, the Abbé Brasseur de Bourbourg, during his long travels in Mexico and Central America, had occasion more than once to come in contact with this trait of the ancient faith of the Nagualists still alive in their descendants. Among the Zapotecs of the Isthmus of Tehuantepec he saw one of the queens of the mystic fraternity, and he describes her with a warmth which proves that he had not lost his eye for the beautiful:

> She wore a piece of light green stuff loosely folded around her form at the hips and falling to a little distance above the ankle; a jacket of red silk gauze with short sleeves and embroidered with gold clothed the upper part of her person, veiling her bosom, upon which lay a chain of heavy gold pieces pierced and strung on a cord. Her rich black hair was divided on the forehead and drawn back in two splendid tresses fastened with blue ribbons, while a white muslin kerchief encircled her head like the calantica of the ancient Egyptians. Never in my life have I seen a more striking figure of an Isis or a Cleopatra.
>
> There was something strange in her expression. Her eyes were the blackest and the brightest in the world; but there were moments when she suddenly paused, leaned against the billiard table or the wall, and they became fixed and dead like those of a corpse. Then a fiery glance would shoot from beneath her dark lashes, sending a chill to the heart of the one to whom it was directed. Was it madness, or was it, as those around her believed, a momentary absence of soul, an absorption of her spirit into its *nagual*, a transportation into an unknown world? Who shall decide? *

24. It would be a mistake to suppose that Nagualism was an incoherent medley of superstitions, a mass of jumbled fragments derived from the ancient paganism. My study of it has led me to a widely different conclusion. It was a perpetuation of a well defined portion of the native cult, whose sources we are able to trace long anterior to the period of the conquest, and which had no connection with the elaborate and bloody ritual of the Aztecs. The evidence to this effect is cogent.

Wherever in later days the Catholic priests found out the holy places and sacred objects of the nagualists, they were in caves or deep rock recesses, not in artificial structures. The myths they gleaned and the names of the gods they heard, also point to this as a distinguishing peculiarity. An early instance is recorded among the Nahuas of Mexico. In 1537 Father Peter discovered a cavern in a deep ravine at Chalma, near Malinalco (a town famous for its magicians), which was the sanctuary of the deity called *Oztoteotl*, the Cave God (*oztotl*, cave, *teotl*, god), venerated throughout the whole empire of Montezuma.* He destroyed the image of the god, and converted the cavern into a chapel.

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* *Voyage à l'Isthmus de Tehuantepec*, p. 164. He adds a number of particulars of the power she was supposed to exercise.

We cannot err in regarding Oztoteotl as merely another name of the Nahuatl divinity Tepeyollotl, the Heart or Inside of the Mountain, who in the Codex Borgia and the Codex Vaticanus is represented seated upon or in a cavern. His name may equally well be translated "the Heart of the Place," or "of the Town."

Dr. Eduard Seler has shown beyond reasonable question that this divinity did not originally belong to the Aztec Pantheon, but was introduced from the South, either from the Zapotecs, the Mixtecs, or the Mayan tribes beyond these.† The Cave God of the Aztecs is identical with the Votan of the Tzentals of Chiapas, and with the U qux Uleuh of the Quiches of Guatemala, and probably with the Cozaana of the Zapotecs.

The rites of all of these were conducted in caverns, and there have been preserved several interesting descriptions of the contents of these sacred places. That relating to the "dark house of Votan" is given thus in the work of the Bishop of Chiapas:

> Votan is the third hero who is named in the calendar, and some of his descendants still reside in the town of Teopisca, where they are known as Votans. He is sometimes referred to as Lord of the Sacred Drum, and he is said to have seen the great wall (which must have been the Tower of Babel), and to have divided this land among the Indians, and given to each tribe its language.

* "Que era venerado en todo el imperio de Montezuma." See *Diccionario Universal*, Appendice, s. v. (Mexico, 1856).

† "Dass der Gott Tepeyollotl im Zapotekenlande und weiter südwärts seine Wurzeln hat und dem eigentlichen Aztekischen Olymp fremd ist, darüber kann kein Zweifel mehr obwalten." See Dr. Seler's able discussion of the subject in the *Compte Rendu* of the Seventh International Congress of Americanists, p. 559, *seq.* The adoption of subterranean temples was peculiarly a Zapotecan trait. "Notandose principalmente en muchos adoratorios de los Zapotecas estan los mas de ellos cubiertos ó en subterraneos espaciosos y lobregos." Carriedo, *Estudios Historicos*, Tom. I, p. 36.

They say further that he once dwelt in Huehuetan, a town in the province of Soconusco. Near there, at the place called Tlazoaloyan, he constructed by blowing with his breath a dark house, and put tapirs in the river, and in the house a great treasure, and left all in charge of a noble lady, assisted by guardians (*tlapianes*) to preserve. This treasure consisted of earthenware vases with covers of the same material, a stone on which were inscribed the figures of the ancient native heroes as found in the calendar, *chalchiuites*, which are green stones, and other superstitious objects.

All of these were taken from the cave and publicly burned in the plaza of Huehuetan on the occasion of our first diocesan visit there in 1691, having been delivered to us by the lady in charge and the guardians. All the Indians have great respect for this Votan, and in some places they call him the Heart of the Towns.*

The English priest Thomas Gage, who was curate of a parish among the Pokonchi Indians of Guatemala about 1630, relates his discovery of such a cave in which the idol was preserved, and gives this description of it:

> We found the Idol standing upon a low stool covered with a linen cloth. The substance of it was wood, black shining like jet, as if it had been painted or smoked; the form was of a man's head unto the shoulders, without either Beard or Mustachoes; his look was grim, with a wrinkled forehead and broad staring eyes.
>
> They boasted of this their god, saying that he had plainly told them they should not believe anything I preached of Christ, but follow the old ways of their forefathers.†

The black color here mentioned was a relic of ancient symbolism, referring to the night, darkness and the obscurity of the holy cavern. Vetancurt informs us that the priests of the ancient paganism were accustomed to rub their faces and bodies with an ointment of fat and pine soot when they went to sacrifice in the forests, so that they looked as black as negroes.‡ In the extract from Nuñez de la Vega already given, *Ical Ahau*, the "Black King," is named as one of the divinities of the nagualists.

In some parts the principal idol found in the caves was the mummied or exsiccated body of some former distinguished priest or chieftain. One such is recorded by Bartholomé de Pisa, which was found among the Zapotecs of Coatlan. It bore a name taken from the calendar, that of the tenth day, and was alleged to be the preserved cadaver of a celebrated ruler.* Another interesting example is narrated by Villa Señor y Sanchez,† who describes it as an eye-witness. It was discovered in a spacious cave located some distance to the west of the city of Mexico, in Nahuatl territory, on the side of what was known as "the Sun mountain"—*la Mesa de Tonati*. He speaks of it as remarkably well preserved, "both the muscles and the bones."

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* *Constituciones Diocesanas*, pp. 9, 10.

† Gage, *A New Survey of the West Indies*, pp. 399, 398.

‡ *Teatro Mexicano*, Tratado III, cap. 11. Mr. Bandelier has called attention to the naming of one of the principal chiefs among the Aztecs *Tlillancalqui*, "Man of the Dark House," and thinks it related to the Votan myth. *Twelfth Annual Report of the Peabody Museum*, p. 689.

> "It was seated in an armchair which served for a throne, and was clothed in a mantle, which fell from the shoulders to the feet. This was richly adorned with precious stones, which, according to the native custom, were sewed into the texture of the cloth. The figure also wore shoulder straps, collars, bracelets and fastenings of silver. From its forehead rose a crown of beautiful feathers of different colors arranged so that one color should alternate with another. The left hand was resting on the arm of the chair, while in the right was a sharp cutlass with silver mountings. At its feet were several vases of fine stone, as marble and alabaster, in which were offerings of blood and meat, obtained from the sacrifices."

The same writer refers to other examples of these sacred caves which he had seen in his journeys. One was near the town of Teremendo, where the sides and roof had been artificially dressed into the shape of huge arches. A natural altar had been provided in a similar manner, and on it, at the time of his visit, were numerous idols in the figures of men and animals, and before them fresh offerings of copal and food. Elsewhere he refers to many such caverns still in use as places resorted to by the natives in *la gran Sierra de Tlascala*.‡

These extracts prove the extent of this peculiar worship and the number of these subterranean temples in recent generations. The fame of some of the greater ones of the past still survives, as the vast grotto of Chalcatongo, near Achiutla, which was the sepulchral vault of its ancient kings; that of Totomachiapa, a solemn scene of sacrifice for the ancient priests; that of Justlahuaca, near Sola (Oaxaca), which was a place of worship of the Zapotecs long after the Conquest; and that in the Cerro de Monopostiac, near San Francisco del Mar.*

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* Herrera, *Historia de las Indias Occidentales*, Dec. iii, Lib. iii, cap. 14.

† Villa Señor, *Teatro Americano*, Lib. v, cap. 38 (Mexico, 1747). Father Cavo adds that there were signs of human sacrifices present, but of this I can find no evidence in the earlier reports. Comp. Cavo, *Los Tres Siglos de Mexico durante el Gobierno Español*, Tom. ii, p. 128.

‡ *Teatro Americano*, Lib. ii, cap. 11; Lib. iii, cap. 13.

The intimate meaning of this cave cult was the worship of the Earth. The Cave God, the Heart of the Hills, really typified the Earth, the Soil, from whose dark recesses flow the limpid streams and spring the tender shoots of the food plants as well as the great trees. To the native Mexican the Earth was the provider of food and drink, the common Father of All; so that to this day when he would take a solemn oath he stoops to the earth, touches it with his hand, and repeats the solemn formula, *Cuix amo nechitla in toteotzin?* "Does not our Great God see me?"

25. The identity of the Tepeyollotl of the Nahuas and the Votan of the Tzentals is shown not only in the oneness of meaning of the names, but in the fact that both represent the *third* day in the ritual calendar. For this reason I take it we find the number *three* so generally a sacred number in the symbolism of the nagualists. We have already learned in the extract from Nuñez de la Vega that the neophytes were instructed in classes of three. To this day in Soteapan the fasts and festivals appointed by the native ministrants are three days in duration.† The semi-Christianized inhabitants of the Sierra of Nayarit, the Nahuatl-speaking Chotas, continued in the last century to venerate three divinities, the Dawn, the Stone and the Serpent,‡ analogous to a similar "trinity" noted by Father Duran among the ancient Aztecs.§

The number *nine*, that is 3 x 3, recurs so frequently in the conjuration formulas of the Mexican sorcerers that de la Serna exclaims: "It was the Devil himself who inculcated into them this superstition about the number nine."‖

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* See Mühlenpfordt, *Mexico*, Bd. ii, pp. 200, 266; Brasseur, *Hist. des Nations Civ. de la Mexique*, Vol. iv, p. 821; Herrera, *Historia de las Indias*, Dec. iii, Lib. iii, cap. 12, etc.

† *Diccion. Universal*, Appendice, s. v.

‡ Their names were Ta Yoapa, Father Dawn; Ta Te, Father Stone; Coanamoa, the Serpent which Seizes. *Dicc. Univ.*, App., Tom. iii, p. 11.

§ Duran, *Historia de los Indios*, Tom. ii, p. 140. They were Tota, Our Father; Yollometli, the Heart of the Maguey (probably pulque); and Topiltzin, Our Noble One (probably Quetzalcoatl, to whom this epithet was often applied).

‖ "Fue el Demonio que les dió la supersticion del numero nueve." *Manual de Ministros*, p. 197.

The other number sacred to the nagualists was *seven* I have in a former essay given various reasons for believing that this was not derived from the seven days of the Christian week but directly from the native calendar * Nuñez de la Vega tells us that the patron of the seventh day was *Cuculcan* the Feathered Serpent and that many nagualists chose him as their special protector As already seen in Guatemala the child finally accepted its *nagual* when seven years old and among some of the Nahuatl tribes of Mexico the *tonal* and the calendar name was formally assigned on the seventh day after birth † From similar impressions the Cakchiquels of Guatemala maintained that when the lightning strikes the earth the thunder stone sinks into the soil but rises to the surface after seven years ‡

The three and the seven were the ruling numbers in the genealogical trees of the Pipiles of San Salvador The tree was painted with *seven* branches representing degrees of relationship within which marriage was forbidden unless a man had performed some distinguished exploit in war when he could marry beyond the nearest *three* degrees of relationship § Another combination of 3 and 7 by multiplication explains the customs among the Mixes of deserting for 21 days a house in which a death has occurred ‖

The indications are that the nagualists derived these numbers from the third and seventh days of the calendar month ' of twenty days Tepeolotlec the Cave God was patron of the third day and also Lord of Animals ' the transformation into which was the test of nagualistic power ¶ Tlaloc god of the mountains and the rains to whom the seventh day was hallowed was represented by the nagualistic symbol of a snake doubled and twisted on itself and was generally portrayed in connection with the Feathered Serpent" (Quetzalcoatl Cuculchan, Gukumatz all names meaning this), represented as carrying his medicine bag, *xiquipilli*, and incensory, the apparatus of the native illuminati, his robe marked with the sign of the cross to show that he was Lord of the Four Winds and of Life *

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* *The Native Calendar of Central America and Mexico* p 12

† Motolinia *Ritos Antiguos Sacrificios e Idolatrias de los Indios de la Nueva España* p. 360 (in *Coleccion de Documentos Ineditos para la Historia de España*)

‡ Thomas Coto *Vocabulario de la lengua Cakchiquel* MS sub voce *Rayo*

§ Herrera *Historia de las Indias* Dec iv Lib viii cap 10

‖ *Diccionario Universal* Appendice ubi suprá

¶ Señor de los Animales *Codex Telleriano Remensis* Parte ii Lam iv

26. The nagualistic rites were highly symbolic, and the symbols used had clearly defined meanings, which enable us to analyze the religious ideas underlying this mysterious cult

The most important symbol was Fire. It was regarded as the primal element and the immediate source of life Father Nicolas de Leon has the following suggestive passage in this connection

> "If any of their old superstitions has remained more deeply rooted than another in the hearts of these Indians, both men and women, it is this about fire and its worship, and about making new fire and preserving it for a year in secret places We should be on the watch for this, and when in their confessions they speak of what the Fire said and how the Fire wept, expressions which we are apt to pass by as unintelligible, we must lay our hands on them for reprehension We should also be on the watch for their baptism by Fire, a ceremony called the *yiahuilloca*,† shortly after the birth of a child when they bestow on it the surnames, nor must the lying in women and their assistants be permitted to speak of Fire as the father and mother of all things and the author of nature, because it is a common saying with them that Fire is present at the birth and death of every creature "

This curious ceremony derived its name from the *yiahuitli*, a plant not unlike the absinthe, the powdered leaves of which, according to Father Sahagun, the natives were accustomed to throw into the flames as an offering to the fire ‡ Long after the conquest, and probably to this day, the same custom prevails in Mexico, the fumes and odor of the burning leaves being considered very salubrious and purifying to the air of the sick room §

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* See Dr Seler's minute description in the *Compte Rendu* of the Eighth Session of the Congrès International des Américanistes, pp 588, 589 In one of the conjuration formulas given by de la Serna (*Manual de Ministros*, p 212) the priest says "Yo soy el sacerdote, el dios *Quetzalcoatl*, que se bajará al infierno, y subiré á lo superior, y hasta los nueve infiernos" This writer, who was very competent in the Nahuatl, translates the name Quetzalcoatl by "culebra con cresta" (*id*, p 171), an unusual, but perhaps a correct rendering.

† His words here are somewhat obscure They are, "El baptismo de fuego, en donde las ponen los sobre nombres que llaman *yahuilloca*, quando nacen" This may be translated, "The baptism of fire in which they confer the names which they call *yahuilloca*" The obscurity is in the Nahuatl, as the word *toca* may be a plural of *tocaitl*, name, as well as the verb *toca*, to throw upon The passage is from the *Camino del Cielo*, fol. 100, verso.

‡ Sahagun, *Historia de la Nueva España*, Lib. iv, cap. 25.

§ It is mentioned as useful for this purpose by the early physicians, Francisco Ximenes, *Cuatro Libros de la Naturaleza*, p. 144, Hernandez, *Hist. Plant. Novæ Hispaniæ*, Tom

The word *yiahuiltoca* means "the throwing of the *yiauhtli*" (from *toca*, to throw upon with the hands). Another name for the ceremony, according to Father Vetancurt, who wrote a century later than Leon, was *apehualco*, which has substantially the same meaning, "a throwing upon" or "a throwing away." * He adds the interesting particulars that it was celebrated on the fourth day after the birth of the child, during which time it was deemed essential to keep the fire burning in the house, but not to permit any of it to be carried out, as that would bring bad luck to the child

Jacinto de la Serna also describes this ceremony, to which he gives the name *tlecuixtliliztli*, "which means that they pass the infant over the fire;' and elsewhere he adds. "The worship of fire is the greatest stumbling-block to these wretched idolaters."†

27. Other ceremonies connected with fire worship took place in connection with the manufacture of the pulque, or *octli*, the fermented liquor obtained from the sap of the maguey plant. The writer just quoted, de Vetancurt, states that the natives in his day, when they had brewed the new pulque and it was ready to be drunk, first built a fire, walked in procession around it and threw some of the new liquor into the flames, chanting the while an invocation to the god of inebriation, Tezcatzoncatl, to descend and be present with them.

This was distinctly a survival of an ancient doctrine which connected the God of Fire with the Gods of Drunkenness, as we may gather from the following quotation from the history composed by Father Diego Duran:

"The *octli* was a favorite offering to the gods, and especially to the God of Fire Sometimes it was placed before a fire in vases, sometimes

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ii, p. 209 Capt. Bourke, in his recent article on "The Medicine Men of the Apaches" (in *Ninth Annual Report of the Bureau of Ethnology*, p 521), suggests that the *yiahuitl* of the Aztecs is the same as the "hoddentin," the pollen of a variety of cat-tail rush which the Apaches in a similar manner throw into the fire as an offering Hernandes, however, describes the *yiahuitl* as a plant with red flowers, growing on mountains and hill-sides—no species of rush, therefore De la Serna says it is the anise plant, and that with it the natives perform the conjuration of the "yellow spirit" (conjuro de amarillo espiritado), that is, of the Fire (*Manual de Ministros*, p. 197).

* From the verb *apeua* Vetancurt's description is in his *Teatro Mexicano*, Tom. i, pp. 462, 463 (Ed. Mexico, 1870).

† His frequent references to it show this See his *Manual de Ministros*, pp. 16, 20, 22, 24, 26, 48, 66, 174, 217, etc. The word *tlecuixtliliztli* is compounded of *tlecuilli*, the hearth or fireplace, and *tlilhuia*, to darken with smoke.

it was scattered upon the flames with a brush, at other times it was poured out around the fireplace."*

28. The high importance of the fire ceremonies in the secret rituals of the modern Mayas is plainly evident from the native Calendars, although their signification has eluded the researches of students, even of the laborious Pio Perez, who was so intimately acquainted with their language and customs. In these Calendars the fire-priest is constantly referred to as *ah-toc*, literally "the fire-master" The rites he celebrates recur at regular intervals of twenty days (the length of one native month) apart. They are four in number On the first he takes the fire; on the second he kindles the fire, on the third he gives it free play, and on the fourth he extinguishes it. A period of five days is then allowed to elapse, when these ceremonies are recommenced in the same order. Whatever their meaning, they are so important that in the *Bul Xoc*, or General Computation of the Calendar, preserved in the mystic "Books of Chilan Balam," there are special directions for these fire-masters to reckon the proper periods for the exercise of their strange functions †

29. What, now, was the sentiment which underlay this worship of fire? I think that the facts quoted, and especially the words of Father de Leon, leave no doubt about it. Fire was worshiped as the life-giver, the active generator, of animate existence. This idea was by no means peculiar to them. It repeatedly recurs in Sanskrit, in Greek and in Teutonic mythology, as has been ably pointed out by Dr. Hermann Cohen ‡ The fire-god Agni (*ignis*) is in the Vedas the Maker of men; Prometheus steals the fire from heaven that he may with it animate the human forms he has moulded of clay, even the connection of the pulque with the fire is paralleled in Greek mythos, where Dionysos is called *Pyrigenes*, the "fire-born."

Among the ancient Aztecs the god of fire was called the oldest of gods *Huehueteotl* and also Our Father *Tota* as it was believed from him all things were derived.* Both among them and the Mayas as I have pointed out in a previous work he was supposed to govern the generative proclivities and the sexual relations.† Another of his names was *Xiuhteuctli* which can be translated God of the Green Leaf that is of vegetable fecundity and productiveness.‡

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* Duran, *Historia de los Indios de la Nueva España*, Tom. ii, p. 210. Sahagun adds that the octli was poured on the hearth at four separate points, doubtless the four cardinal points. *Historia de Nueva España*, Lib i, cap. 13 De la Serna describes the same ceremony as current in his day, *Manual de Ministros*, p 83. The invocation ran —"Shining Rose, light-giving Rose, receive and rejoice my heart before the God."

† A copy of these strange "Books of Chilan Balam" is in my possession. I have described them in my *Essays of an Americanist* (Philadelphia, 1890).

‡ See his remarks on "Apperception der Menschenzeugung als Feuerbereitung," in the *Zeitschrift für Völkerpsychologie*, Bd. vi, s 113, *seq.*

To transform themselves into a globe or ball of fire was as we have seen (ante p. 29) a power claimed by expert nagualists and to handle it with impunity or to blow it from the mouth was one of their commonest exhibitions. Nothing so much proved their superiority as thus to master this potent element.

30 The same name above referred to the Heart of the Town or of the Hills was that which at a comparatively late date was applied to an idol of green stone preserved with religious care in a cavern in the Cerro de Monopostiac not far from San Francisco del Mar. The spot is still believed by the natives to be enchanted ground and protected by superhuman powers.§

These green stones called *chalchiuitl* of jadeite nephrite green quartz or the like were accounted of peculiar religious significance throughout southern Mexico and probably to this day many are preserved among the indigenous population as amulets and charms. They were often carved into images either in human form or representing a frog the latter apparently the symbol of the waters and of fertility. Bartholomè de Alva refers to them in a passage of his Confessionary. The priest asks the penitent

> Dost thou possess at this very time little idols of green stone or frogs made of it (*in chalchiuh coconeme chalchiuh tamasoltin*)?
>
> Dost thou put them out in the sun to be warmed? Dost thou keep them wrapped in cotton coverings with great respect and veneration?
>
> Dost thou believe and hold for very truth that these green stones give thee food and drink even as thy ancestors believed who died in their idolatry? Dost thou believe that they give thee success and prosperity

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* Sahagun *Historia de Nueva España* Lib 1 cap. 13. The Nahuatl text is more definite than the Spanish translation

† See my *Myths of the New World* p. 154 seq

‡ In the Nahuatl language the word *xiuitl* (*xihuitl*) has four meanings a plant a turquoise a year and a comet

§ J B Carriedo *Estudios Historicos del Estado Oaxaqueño* Tom 1 p. 82 etc.

and good things, and all that thou hast or wishest? Because we know very well that many of you so believe at this very time."[*]

Down to quite a recent date, and perhaps still, these green stones are employed in certain ceremonies in vogue among the Indians of Oaxaca in order to ensure a plenteous maize harvest. The largest ear of corn in the field is selected and wrapped up in a cloth with some of these chalchiuite At the next corn-planting it is taken to the field and buried in the soil This is believed to be a relic of the worship of the ancient Zapotec divinity, Quiegolani, who presided over cultivated fields.[†]

They are still in use among the natives as lucky stones or amulets. In the Zotzil insurrection of 1869, already referred to, one was found suspended to the neck of one of the slain Indians It came into the possession of M Maler, who has described and figured it.[‡] It represents a human head with a curious expression and a singular headdress.

From specimens of these amulets preserved in museums it is seen that any greenish stone was selected, preferably those yielding a high, vitreous polish, as jadeite, turquoise, emerald, chlormelanite or precious serpentine. The color gave the sacred character, and this, it seems to me, was distinctly meant to be symbolic of water and its effects, the green of growing plants, and hence of fertility, abundance and prosperity

31. There is another symbol, still venerated among the present indigenous population, which belongs to Nagualism, and is a survival from the ancient cult; this is the Tree. The species held in especial respect is the ceiba, the silk-cotton tree, the *ytzamatl* (knife-leaved paper tree) of the Nahuas, the *yax che* (green, or first tree) of the Mayas, the *Bombax ceiba* of the botanists. It is of great size and rapid growth. In Southern Mexico and Central America one is to be seen near many of the native villages, and is regarded as in some way the protecting genius of the town.

Sacred trees were familiar to the old Mexican cult, and, what is curious, the same name was applied to such as to the fire,

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[*] Alva, *Confessionario en Lengua Mexicana*, fol. 9.

[†] Carriedo, *Estudios Historicos*, pp. 6, 7.

[‡] In the *Revue d' Ethnographie*, Tom. iii, p. 213. Some very fine objects of this class are described by E. G. Squier, in his "Observations on the Chalchihuitl," in the *Annals of the Lyceum of Natural History*, Vol. i (New York, 1869).

Tota Our Father They are said to have represented the gods of woods and waters * In the ancient mythology we often hear of the tree of life ' represented to have four branches each sacred to one of the four cardinal points and the divinities associated therewith

The conventionalized form of this tree in the Mexican figurative paintings strongly resembles a cross Examples of it are numerous and unmistakable as for instance the cruciform tree of life rising from a head with a protruding tongue, in the Vienna Codex †

32. Thus the sign of the cross either the form with equal arms known as the cross of St Andrew which is the oldest Christian form or the Latin cross with its arms of unequal length came to be the ideogram for life in the Mexican hieroglyphic writing and as such with more or less variants was employed to signify the *tonalli* or *nagual* the sign of nativity the natal day the personal spirit ‡ The ancient document called the Mappe Quinatzin offers examples and its meaning is explained by various early writers The peculiar character of the Mexican ritual calendar by which nativities were calculated favored a plan of representing them in the shape of a cross, as we see in the singular *Codex Cruciformis* of the Boturini Goupil collection

33. But the doctrines of Nagualism had a phase even more detestable to the missionaries than any of these an esoteric phase which brought it into relation to the libidinous cults of Babylon and the orgies of the Witches' Sabbaths " of the Dark Ages Of these occult practices we of course have no detailed descriptions but there are hints and half glances which leave us in no doubt

When the mysterious metamorphosis of the individual into his or her *nagual* was about to take place, the person must strip to absolute nudity * and the lascivious fury of bands of naked Nagualists meeting in remote glades by starlight or in the dark recesses of caves dancing before the statues of the ancient gods were scenes that stirred the fanaticism of the Spanish missionaries to its highest pitch Bishop Landa informs us that in Yucatan the dance there known as the *naual* was one of the few in which both men and women took part and that it "was not very decent" It was afterwards prohibited by the priests We have excellent authority that such wild rites continued well into the present century close to the leading cities of the State † and it is highly likely that they are not unknown to day

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* Diego Duran *Historia de los Indios de Nueva España* Tom ii p 140

† In Kingsborough *Antiquities of Mexico* Vol ii Pl 180 On the cross as a form derived from a tree see the observations of W H Holmes in the *Second Annual Report of the Bureau of Ethnology* pp 2 0 271

‡ Au Mexique le cadre en isé la croix en sautoir comme celle de St André avec quelques variantes représentait le signe de nativité *tonalli* la fête le jour natal M Aubin in Boban *Catalogue Raisonné de la Collection Goupil* Tom i p 227 Both Gomara and Herrera may be quoted to this effect

34. Moreover it is certain that among the Nagualists one of their most revered symbols was the *serpent* in Chiapas one of their highest orders of the initiated was that of the *chanes* or serpents Not only is this in Christian symbolism the form and sign of the Prince of Evil and the enemy of God but the missionaries were aware that in the astrological symbols of ancient Mexico the serpent represented the *phallus* that it was regarded as the most potent of all the signs ‡ and modern research has shown contrary to the opinion long held, that there was among these nations an extraordinary and extensive worship of the reciprocal principle of nature associated with numerous phallic emblems §

Huge phalli of stone have been discovered one for instance on the Cerro de las Navajas not far from the city of Mexico and another in the State of Hidalgo.[*] Probably they were used in some such ceremonies as Oviedo describes among the Nahuas of Nicaragua, where the same symbol was represented by conical mounds of earth, around which at certain seasons the women danced with libidinous actions. Although as a general rule the pottery of ancient Mexico avoids obscenity, Brasseur stated that he had seen many specimens of a contrary character from certain regions,[†] and Dr. Berendt has copied several striking examples, showing curious *yoni* symbols, which are now in my possession

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* See a curious story from native sources in my *Essays of an Americanist* p [illegible] It adds that this change can be prevented by casting salt upon the person

† Benito Maria de Moxo *Cartas Mejicanas* p 2 7 Landa *Cosas de Yucatan* p 198

‡ Pedro de los Rios in his notes to the Codex Vaticanus published in Kingsborough's great work assigns the sign *coatl* the serpent to "il membro virile *il maggior augurio di tutti gli altri*" It is distinctly so shown on the 75th plate of the Codex Don de la Serna states that in his day some of the Mexican conjurors used a wand around which was fastened a living serpent *Manual de Ministros* p 9

§ There is abundant evidence of this in certain plates of the Codex Troano and there is also alleged to be much in the Codex Mexicanus of the *Palais Bourbon* Writing about the latter M Aubin said as far back as 1841— le culte du lingam ou du phallus n etait pas etranger aux Mexicains ce qu etablissent plusieurs documents peu connus et des sculptures découvertes depuis un petit nombre d années His letter is in Boban *Catalogue Raisonné de la Collection Goupil* Tom ii, p 207 On the frequent identification of the serpent symbol with the phallus in classical art consult Dr Anton Nagele s article Der Schlangen Cultus in the *Zeitschrift für Völkerpsychologie* Band xvii p 85 *seq*

We may explain these as in some way connected with the worship of Pantecatl, the male divinity who presided over profligate love, and of Tlazolteotl, the *Venus Impudica* of the Aztec pantheon; and it is not without significance that the cave-temple of Votan, whose contents were destroyed by the Bishop of Chiapas, in 1691 (see above, p. 47), was located at *Tlazoaloyan*, both names being derived from a root signifying sexual action.[‡] The other name of the divinity, called "the Heart of the Hills," is in Quiche, Alom, "he who begets," and the Zapotec Cozaana, another analogue of the same deity, is translated by Seler, "the Begetter." Such facts indicate how intimately the esoteric doctrines of Nagualism were related to the worship of the reproductive powers of nature.

35. It will readily be understood from what has been said that Nagualism was neither a pure descendant of the ancient cults, nor yet a derivative from Christian doctrines and European superstitions. It was a strange commingling of both, often in grotesque and absurd forms. In fact, the pretended Christianity of the native population of Mexico to-day is little more than a figment, according to the testimony of the most competent observers.[§]

The rituals and prayers of the nagualists bear witness to this. It is very visible in those I have quoted from Nuñez de la Vega, and I can add an interesting example of it which has not heretofore been published. I take it from the MSS. of Father Vicente Hernandez Spina, cura of Ixtlavacan, in Guatemala, a remote village of the Quiches. He wrote it down in the native tongue about forty years ago, as recited by an *ah kih*, "reader of days," a native master of the genethliac art, who had composed it in favor of a client who had asked his intercession.

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[*] Cf. G Tarayre, *Exploration Mineralogique des Regions Mexicaines*, p 283 (Paris, 1869), and *Bulletin de la Société d'Anthropologie de Paris*, Juin, 1893.

[†] *Sources de l'Histoire Primitive de Mexique*, p. 81.

[‡] From *so*, to join together. Compare my *Essays of an Americanist*, p. 417 (Philadelphia, 1890).

[§] "El indio Mexicano es todavia idolatra." F Pimentel, *La Situacion actual de la Raza Indigena de Mexico*, p. 197.

Prayer of an Ah-Kih.

"O Jesus Christ my God thou God the Son, with the Father and the Holy Spirit, art my only God To day, on this day, at this hour, on this day Tihax, I call upon the holy souls which accompany the sun-rising and the sun-settling of the day with these holy souls I call upon thee, O chief of the genii, thou who dwellest in this mountain of Siba Raxquin, come, ye holy spirits of Juan Vachiac, of Don Domingo Vachiac, of Juan Ixquiaptap, the holy souls of Francisco Excoquieh, of Diego Soom, of Juan Fay, of Alonzo Tzep, I call the holy souls of Diego Tziquin and of Don Pedro Noh you, O priests, to whom all things are revealed, and thou, chief of the genii, you, lords of the mountains, lords of the plains, thou, Don Purupeto Martin, come, accept this incense, accept to-day this candle.*

"Come also, my mother Holy Mary, the Lord of Esquipulas, the Lord of Capetagua, the beloved Mary of Chiantla, with her who dwells at San Lorenzo, and also Mary of Sorrows, Mary Saint Anna, Mary Tiburcia, Mary of Carmen, with Saint Michael the Archangel, the captain St James, St. Christoval, St Sebastian, St. Nicolas, St. Bonaventura, St. Bernardin, St. Andrew, St. Thomas, St. Bartholomew, and thou my beloved mother St. Catherine, thou beloved Mary of the Conception, Mary of the Rosary, thou lord and king Pascual, be here present.

"And thou, Frost, and thou, excellent Wind, thou, God of the plain, thou, God of Quiac-Basulup, thou, God of Retal-Uleu, thou, lord of San Gregorio, thou, lord of Chil-Masa. [These are mountains and localities, and in the original there follow the names of more than a hundred others. The prayer concludes as follows :]

" . . . . I who appoint myself godfather and godmother, I who ask, I the witness and brother of this man who asks, of this man who makes himself your son, O holy souls, I ask, do not let any evil happen unto him, nor let him be unhappy for any cause.

"I the priest, I who speak, I who burn this incense, I who light this candle, I who pray for him, I who take him under my protection, I ask you that he may obtain his subsistence with facility. Thou, God, canst provide him with money ; let him not fall ill of fever ; I ask that he shall not become paralytic that he may not choke with severe coughing that he be not bitten by a serpent that he become neither bloated nor asthmatic that he do not go mad that he be not bitten by a dog that he be not struck by lightning that he be not choked with brandy that he be not killed with iron nor by a stick and that he be not carried off by an eagle guard him O clouds aid him O lightning aid him O thunder aid him St Peter aid him St Paul aid him eternal Father

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* The "holy souls" who are here appealed to by name are those of deceased *ah kih*, or priests of the native cult.

And I who up to this time have spoken for him to you I ask you that sickness may visit his enemies So order it that when his enemies go forth from their houses they may meet sickness order it that wherever they go they may meet troubles do your offices of injury to them wheresoever they are met do this that I pray O holy souls God be with you God the Father God the Son God the Holy Spirit Amen Jesus

Most of such invocations are expressed in terms far more recondite and symbolic than the above We have many such preserved in the work of Jacinto de la Serna, which supply ample material to acquaint us with the peculiarities of the sacred and secret language of the nagualists I shall quote but one that employed in the curious ceremony of calling back the *tonal* ' referred to on a previous page I append an explanation of its obscure metaphors

Invocation for the Restitution of the Tonal

' Ho there! Come to my aid mother mine of the skirt of precious stones![1] What keeps thee away gray ghost white ghost?[2] Is the obstacle white or is it yellow? See I place here the yellow enchantment and the white enchantment[3]

I the Master of the Masters of enchantments have come I who formed thee and gave thee life[4] Thou mother mine of the starry skirt thou goddess of the stars who givest life why hast thou turned against this one?[5]

' Adverse spirit and darkened star I shall sink thee in the breadth and depth of the waters[6] I master of spells speak to thee Ho there! Mother mine whose skirt is made of gems come seek with me the shining spirit who dwells in the house of light[7] that we may know what god or mighty power thus destroys and crushes to earth this unfortunate one Green and black spirit of sickness leave him and seek thy prey elsewhere

"Green and yellow ghost who art wandering as if lost, over mountains and plains, I seek thee I desire thee, return to him whom thou hast abandoned Thou, the nine times beaten the nine times smitten see that thou fail me not[8] Come hither, mother mine, whose robe is of precious gems, one water, two waters, one rabbit, two rabbits, one deer, two deers; one alligator, two alligators[9]

"Lo! I myself am here; I am most furious, I make the loudest noise of all, I respect no one, even sticks and stones tremble before me What god or mighty power dare face me, me, a child of gods and goddesses?[10] I have come to seek and call back the *tonal* of this sick one, wherever it is, whithersoever it has wandered, be it nine times wandered, even unto the nine junctures and the nine unions[11] Wherever it is, I summon it to return, I order it to return, and to heal and clean this heart and this head"

Explanations.

1. The appeal is to Water, regarded as the universal Mother The "skirt of precious stones" refers to the green of the precious green stones, a color sacred to water

2 The question is addressed to the *tonal*

3. The yellow enchantment is tobacco, the white, a cup of water.

4 That is, assigned the form of the nagual belonging to the sick man.

5 This appeal is directed to the Milky Way

6. The threat is addressed to the *tonal*, to frighten it into returning

7. The "shining spirit" is the Fire-god.

8. The yellow tobacco, prepared ceremonially in the manner indicated.

9. These are names of days in the native calendar which are invoked

10. The priest speaks in the person of his god.

11 Referring to the Nahuatl belief that there are nine upper and nine under worlds.

From the same work of de la Serna I collect the following list of symbolic expressions. It might easily be extended, but these will be sufficient to show the figurative obscurities which they threw around their formulas of conjuration, but which were by no means devoid of coherence and instruction to those who could understand them.

Symbolic Expressions of the Nagualists.

Blood—"The red woman with snakes on her gown" (referring to the veins).

Copal Gum.—"The white woman" (from the whitish color of the fresh gum).

Cords (for carrying burdens).—"The snake that does woman's work" (because women sit still to knit, and the cord works while itself is carried).

Drunkenness.—"My resting time," or "when I am getting my breath."

The Earth.—"The mirror that smokes" (because of the mists that rise from it) "the rabbit with its mouth upward (the rabbit in opposition to the one they see in the moon with its mouth upward because of the mists which rise from it like the breath exhaled from the mouth) the flower which contains everything (as all fruit proceeds from flowers so does all vegetable life proceed from the earth which is therefore spoken of as a flower), the flower which bites the mouths (a flower for the reason given it eats the mouths because all things necessarily return to it and are swallowed by it)

Fingers — The five fates or the five works or the five fields (because by the use of his fingers man works out his own destiny Hence also the worship of the Hand among the Nahuas as the god Maitl and among the Mayas as the god Kab both which words mean hand)

Fire — Our Father of the Four Reeds (because the ceremony of making the new fire was held on the day Four Reeds 4 Acatl) the shining rose the yellow flyer the red haired one the yellow spirit

A Knife of Copper — The yellow Chichimec (because the Chichimecs were alleged to tear out the bowels of their enemies)

The Maguey Plant — My sister the eight in a row (because it was planted in this manner)

A Road — That which is divided in two and yet has neither beginning middle nor end (because it always lies in two directions from a person and yet all roads lead into others and thus never end)

Sickness — The red woman the breath of the flame,' our mother the comet (all referring to the fever) the Chichimec (because it aims to destroy life like these savage warriors) the spider (because of its venomous nature)

Smoke — The old wife (i e of the fire)

The Sun — Our holy and pockified Uncle (referring to the myth of Nanahuatl who was syphilitic and leaping into the flames of a fire rose as the sun)

Tobacco — The nine (or seven) times beaten" (because for sacred purposes it was rubbed up this number of times) 'the enchanted gray one' (from its color and use in conjuring)

Water — The Green Woman (from the greenness which follows moisture) our Mother whose robe is of precious stones' (from the green or vegetable life resembling the turquoise emerald jade, etc)

36. It might be asked how the dark arts and secret ceremonies of the Nagualists escaped the prying eyes of the officers of the Holy Inquisition, which was established in Mexico in 1571 The answer is, that the inquisitors were instructed by Cardinal Diego de Espinosa, who at that time was Inquisitor General and President of the Council of the Indies, "to abstain from proceedings against Indians, because of their stupidity and incapacity, as well as scant instruction in the Holy Catholic faith, for the crimes of heresy, apostasy, heretical blasphemy, sorcery, incantations, superstitions," etc.

Energetic inquisitors, however, conceded very grudgingly this exemption. In the imposing *auto de fé* celebrated in the city of Mexico, in 1659, a half-breed, Bernardo del Carpio by name, son of a full-blood Indian mother, accused of blasphemy, etc., endeavored to escape the Holy Office by pleading his Indian blood; but his appeal was disallowed, and the precedent established that any admixture whatever of European blood brought the accused within the jurisdiction of the Inquisition.* Even this seems to have been a concession, for we find the record of an *auto de fé* held in 1609, in the province of Tehuantepec, in which eight full-blood natives were punished for worshiping the goddess Pinopiaa.† Mr. David Ferguson, however, who has studied extensively the records of the inquisition in Mexico, informs me that in none of the trials read by him has he observed any charges of Nagualism, although many white persons were accused, and some tried, for consulting Indian sorcerers.

37. It will be seen from what I have said, that the rites of Nagualism extended as widely as did the term over Mexico and Central America. It becomes, therefore, of importance to discover from what linguistic stock this term and its associated words are derived. From that source it is reasonable to suppose the rites of this superstition also had their origin.

The opinions on this subject have been diverse and positive. Most writers have assumed that it is a Nahuatl, or pure Mexican, word; while an eminent authority, Dr. Stoll, is not less certain that it is from a radical belonging to the neighboring great stock of the Mayan dialects, and especially the Quiche, of Guatemala.‡ Perhaps both these positions are erroneous, and we must look elsewhere for the true etymology of these expressions Unquestionably they had become domesticated in both Maya and Nahuatl but there is some reason to think they were loan words belonging to another and perhaps more venerable civilization than either of these nations could claim

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* See the *Relacion del Auto celebrado en Mexico, año de 1659* (Mexico, En la Imprenta del Santo Officio, 1659).

† J. B. Carriedo, *Estudios Historicos del Estado Oaxaqueno*, Tom. 1, pp. 8, 9 (Oaxaca, 1849). About 1610 a number of Indians in the province of Acapulco were put to death for having buried enchanted ashes beneath the floor of a chapel! (Serna, *Manual de Ministros*, p. 52.)

‡ "Nagual ist in seiner correcten Form *naoal* ein echtes Quiché-Wort, ein Substantivum instrumentale, vom Stamme *naó*, wissen, erkennen. *Naoal* ist dasjenige, womit oder woran etwas, in diesem Falle das Schicksal des Kindes, erkannt wird, und hat mit dem mexikanischen *nahualli* (Hexe), mit dem man es vielleicht in Verbindung bringen möchte, nichts zu schaffen." *Guatemala*, s. 281.

To illustrate this I shall subjoin several series of words derived from the same radical which is at the basis of the word nagual the series three in number being taken from the three radically diverse though geographically contiguous, linguistic stocks the Maya the Zapotec and the Nahuatl

From the Maya of Yucatan

Naual or *nautal* a native dance forbidden by the missionaries
Na util, talent skill ability
Na it intelligence wisdom
Niatah to understand to divine
Nanaol to consider to contemplate to meditate to commune with oneself to enter into oneself
Noh great skillful as *noh ahceh*, a skillful hunter

From Maya Dialects

QUICHE CAKCHIQUEL

Naual a witch or sorcerer
Nawalin to tell fortunes to predict the future
Qui naualin to sacrifice to offer sacrifices
Na to feel to suspect to divine to think in one s heart
Nao to know to be alert or expert in something
Naol a skillful person a rhetorician
Naotisin to make another intelligent or astute
Nat il the memory
Natub the soul or shadow of a man
Noh the god of reason (Genius der Vernunft Scherzer)
Noh to fecundate to impregnate (*Popol Vuh*)

TZENTAL

X qna to know
X qnaulat to know often or thoroughly (frequentative)
Naom wise astute (*naom vinic* hombre sabio)
Naoghi art, science
Naoghibal memory
Ghnaoghel, a wise man
Alaghom naom, the Goddess of Wisdom

From the Zapotec, of Oaxaca.

Nana, gana, gòna, to know
Nona, to know thoroughly, to retain in the memory
Nana ticha, or *nona lu*, a wise man
Guela nana, or *guela nona*, wisdom, knowledge
Hue gona, or *ro gona*, a teacher, a master
Na lu, truth , *ni na lu*, that which is true.
Naciña, or *naciina*, skill, dexterity
Hui naa, a medicine man, a "nagualist."
Nahaa, to speak pleasantly or agreeably
Nayaa, or *nayapi*, to speak easily or fluently
Riyoo gona, to sacrifice, to offer sacrifice
Ni nana, the understanding, the intelligence, generally.
Nayani, the superior reason of man
Nayaa, } superiority, a superior man (gentileza, gentil hombre)
Nagun, }

From the Nahuatl, of Mexico.

Naua, to dance, holding each other by the hands
Naualli, a sorcerer, magician, enchanter
Nauallotl, magic, enchantment, witchcraft
Nauatl, or *nahuatl*, skillful, astute, smart , hence, superior , applied to language, clear, well-sounding, whence (perhaps) the name of the tongue.
Nauati, to speak clearly and distinctly.
Nauatlato, an interpreter.

38. I believe that no one can carefully examine these lists of words, all taken from authorities well acquainted with the several tongues, and writing when they still retained their original purity, without acknowledging that the same radical or syllable underlies them all; and further, that from the primitive form and rich development of this radical in the Zapotec, it looks as if we must turn to it to recognize the origin of all these expressions, both in the Nahuatl and the Maya linguistic stocks.

The root *na*, to know, is the primitive monosyllabic stem to which we trace all of them. *Nahual* means knowledge, especially mystic knowledge, the Gnosis, the knowledge of the hidden and secret things of nature; easily enough confounded in uncultivated minds with sorcery and magic.*

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* The Abbé Brasseur observes: "Le mot *nahual*, qui vet dire toute science, ou science de tout, est fréquemment employé pour exprimer la sorcellerie chez ces populations." *Bulletin de la Société de Géographie*, 1857, p 290. In another passage of his works the speculative Abbé translates *naual* by the English "know all," and is not averse to believing that the latter is but a slight variant of the former.

It is very significant that neither the radical *na* nor any of its derivatives are found in the Huasteca dialect of the Mayan tongue, which was spoken about Tampico, far removed from other members of the stock. The inference is that in the southern dialects it was a borrowed stem.

Nor in the Nahuatl language—although its very name is derived from it*—does the radical *na* appear in its simplicity and true significance. To the Nahuas also it must have been a loan.

It is true that De la Serna derives the Mexican *naualli*, a sorcerer, from the verb *nahualtia*, to mask or disguise oneself, "because a *naualli* is one who masks or disguises himself under the form of some lower animal, which is his *nagual*;"† but it is altogether likely that *nahualtia* derived its meaning from the custom of the medicine men to wear masks during their ceremonies.

Therefore, if the term *nagual* and many of its associates and derivatives were at first borrowed from the Zapotec language, a necessary corrollary of this conclusion is that along with these terms came most of the superstitions, rites and beliefs to which they allude, which thus became grafted on the general tendency to such superstitions existing everywhere and at all times in the human mind.

Along with the names of the days and the hieroglyphs which mark them, and the complicated arithmetical methods by means of which they were employed, were carried most of the doctrines of the Nagualists, and the name by which they in time became known from central Mexico quite to Nicaragua and beyond.

The mysterious words have now, indeed, lost much of their ancient significance. In a recent dictionary of the Spanish of Mexico *nagual* is defined as "a witch, a word used to frighten children and make them behave;"‡ while in Nicaragua, where the former Nahuatl population has left so many traces of its presence in the language of to-day, the word *nagual* no longer means an actor in the black art, or a knowledge of it, but his or her

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[*] See an article by me entitled "On the Words Anahuac and Nahuatl," in the *American Antiquarian* for November, 1893.

[†] *Manual de Ministros*, p. 50.

[‡] Jesus Sanchez, *Glosario de Voces Castellanas derivadas del Idioma Nahuatl*, sub voce.

armamentarium, or the box, jar or case in which are kept the professional apparatus, the talismans and charms, which constitute the stock in trade or outfit of the necromancer [*]

Among the Lacandons, of Mayan stock, who inhabit the forests on the upper waters of the Usumacinta river, at the present day the term *naguale* or *nagullat* is said to be applied to any one "who is entitled to respect and obedience by age and merit;" [†] but in all probability he is also believed to possess superior and occult knowledge.

39. All who have any acquaintance with the folk-lore of the world are aware that the notion of men and women having the power to change themselves into beasts is as wide as superstition itself and older than history. It is mentioned in the pages of Herodotus and in the myths of ancient Assyria. It is the property of African negroes, and the peasantry of Europe still hold to their faith in the reality of the were-wolf of Germany, the *loup garou* of France and the *lupo mannaro* of Italy Dr. Richard Andrée well says in his interesting study of the subject: "He who would explain the origin of this strange superstition must not approach it as a national or local manifestation, but as one universal in its nature; not as the property of one race or family, but of the species and its psychology at large." [‡]

Even in such a detail as the direct connection of the name of the person with his power of change do we find extraordinary parallelisms between the superstition of the red man of America and the peasant of Germany. As in Mexico the *nagual* was assigned to the infant by a form of baptism, so in Europe the peasants of east Prussia hold that if the godparent at the time of naming and baptism thinks of a wolf, the infant will acquire the power of becoming one; and in Hesse to pronounce the name of the person in the presence of the animal into which he has been changed will restore him to human shape [§]

40. I need not say that the doctrine of personal spirits is not especially Mexican, nor yet American; it belongs to man in

[*] "*Nagual*—el lugar, rincon, cajon, nambira, etc., donde guarda sus talismanes y trajes de encanta la bruja" Berendt, *La Lengua Castellana de Nicaragua*, MS.

[†] Emeterio Pineda, *Descripcion Geografica de Chiapas y Soconusco*, p. 23 (Mexico, 1845).

[‡] See his article "War-wolf," in his *Ethnographische Parallelen und Vergleiche*, p. 62, *seq.*

[§] Richard Andrée, *ibid.*, pp. 63, 64.

general, and can be recognized in most religions and many philosophies In ancient Greece both the Platonicians and later the Neo Platonicians thought that each individual has a particular spirit or *daimon* in whom is enshrined his or her moral personality To this *daimon* he should address his prayers and should listen heedfully to those interior promptings which seem to arise in the mind from some unseen silent monitor *

Many a member of the Church of Rome substitutes for the *daimon* of the Platonists the patron saint after whom he is named or whom he has chosen from the calendar the hagiology of his Church This analogy did not fail to strike the early missionaries, and they saw in the Indian priest selecting the *najual* of the child a hideous and diabolical caricature of the holy rites

But what was their horror when they found that the similarity proceeded so far that the pagan priest also performed a kind of baptismal sacrament with water and that in the Mexican picture writing the sign which represents the natal day, the *tonal*, by which the individual demon is denoted, was none other than the sign of the cross, as we have seen This left no doubt as to the devilish origin of the whole business, which was further supported by the wondrous thaumaturgic powers of its professors

41. How are we to explain these marvelous statements? It will not do to take the short and easy road of saying they are all lies and frauds The evidence is too abundant for us to doubt that there was skillful jugglery among the proficients in the occult arts among those nations They could rival their colleagues in the East Indies and Europe, if not surpass them

Moreover, is there anything incredible in the reports of the spectators? Are we not familiar with the hypnotic or mesmeric conditions in which the subject sees, hears and feels just what the master tells him to feel and see? The tricks of cutting oneself or others, of swallowing broken glass, of handling venomous reptiles, are well known performances of the sect of the Aissaoua in northern Africa, and nowadays one does not have to go off the boulevards of Paris to see them repeated The phenomena of thought transference, of telepathy, of clairvoyance, of spiritual rappings, do but reiterate under the clear light of the close of the nineteenth century the mystical thaumaturgy with which these children of nature were familiar centuries ago in the New World, and which are recorded of the theosophists and magicians of Egypt, Greece and Rome.* So long as many intelligent and sensible people among ourselves find all explanations of these modern phenomena inadequate and unsatisfactory, we may patiently wait for a complete solution of those of a greater antiquity.

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* See Alfred Maury *La Magie et l'Astrologie* pp 88 89 267 etc

42. The conclusion to which this study of Nagualism leads is, that it was not merely the belief in a personal guardian spirit, as some have asserted, not merely a survival of fragments of the ancient heathenism, more or less diluted by Christian teachings, as others have maintained; but that above and beyond these, it was a powerful secret *organization*, extending over a wide area, including members of different languages and varying culture, bound together by mystic rites, by necromantic powers and occult doctrines; but, more than all, by one intense emotion—hatred of the whites—and by one unalterable purpose—that of their destruction, and with them the annihilation of the government and religion which they had introduced.

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* In the *Notice Préliminaire* to the second part of his work, *La Magie et l'Astrologie dans l'Antiquité et au Moyen Age*, Mr Alfred Maury admirably sums up the scientific resources at our command for explaining the mystical phenomena of experience, without denying their reality as actual occurrences.

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The Yolk Nucleus in Cymatogaster aggregatus Gibbons

By Jesse W Hubbard *

(Read before the American Philosophical Society December 15 1893)

The so called yolk nucleus is a compact irregular mass of granules found in the yolk of the eggs of certain animals It lies outside the germinal vesicle and usually takes a deep stain similar to the nucleolus within the germinal vesicle

It has been seen in the eggs of Cnidarians (Hacker and others) Nematodes (Monticelli) Sagitta (Hertwig) Crustaceans (Weismann and others) Myriopods (Ludwig) Insects (Balbiani) Arachnids (Carus Ludwig and others) Lamellibranchs (Ihering) Gastropods (Balbiani) Teleosteans (Van Bambeke) Batrachians (Cramer Carus and others) Reptiles (Eimer) Aves (Cramer and others) Mammals (Schafer) It is probably a normal structure of fish eggs but on account of unfavorable conditions its complete history has not been traced in any species

The problem we wish to solve is (1) How does this body originate (2) what becomes of it (3) what function has it in the egg? There are many difficulties to the solution of the problem by ordinary fish eggs Their great size complexity of structure owing to accumulation of yolk close proximity to each other and liability to crumble in sectioning—all are a detriment to its study

Cymatogaster has in these respects many advantages over all others (1) The eggs of this genus are the smallest of fish eggs hence a few sections show the entire egg The eggs of Cymatogaster reach a maximum size of 3 mm in diameter while other fish eggs average about 1 mm in diameter (2) There are comparatively few eggs in each ovary so they are not distorted by crowding (3) In their natural state if uninjured by reagents, they are perfectly spherical and thus admit of easy measurement (4) There is but little yolk when ripe and hence they may be sectioned without crumbling (5) The nucleus seldom contains many nucleoli It generally has but one distinct nucleolar spot In very young eggs and those about ripe a few others may be seen, not more than four or five (6) The last and most important advantage these eggs possess is the fact that the yolk nucleus is conspicuous from the time the eggs have reached a diameter of 20 μ until maturation and even beyond that to the closing of the blastopore !

The observations were made on ovaries collected by Dr Carl Eigenmann on the coast of California They represent individuals from 17 mm to 140 mm in length and were preserved chiefly in June July and August and in October, November December January and February Most of them were preserved in Flemming s strong mixture of osmic chromic-acetic A few others in platinum chloride and corrosive sublimate Those killed in the two last mentioned were not very favorable for the study of the yolk nucleus Some of the ovaries were stained in toto by hæmatoxylin Others were stained on the slide by eosin This is an excellent stain for eggs near maturity. The former was the better for younger eggs After clearing with clove oil and infiltration in paraffin they were cut and mounted in Canada Balsam

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* Contributions from the Zoölogical Laboratory of the Indiana University under the direction of Carl Eigenmann iii

I made a number of experiments with different staining media Neither mythyl green, mythyl violet, dahlia or safranin sufficiently differentiated the tissues and the body I wished to trace I found, however, that mythyl violet did not stain anything in the ovary, but did stain the outside muscular tissue and the spermatazoans contained in the ovary, the latter being stained a bright violet Using alcoholic eosin and methyl violet as a double stain rendered all the tissues red except the spermatozoons, which were a bright violet

I have examined the ovaries of very small fish measuring 17 mm , 29 mm , 35 mm and 40 mm. in length In none of the largest eggs of these did I find any trace of a yolk nucleus In a fish 45 mm long I found a few eggs which seemed to have this body, but not at all distinct, as the ovary was not well preserved The adult fish reaches a length 140 mm In a fish 70 mm long I found this body quite distinct So it must appear in the egg when the fish is between 40 mm and 70 mm in length. But, as I had no specimens between these two sizes, I cannot definitely determine just when it appears in the egg

In the young, 40 mm and less in length, the largest eggs measure 35 μ, 30 μ, 25 μ. In none of these eggs was the body visible in the protoplasm of the egg. But eggs about the same size as above found in an ovary of an adult fish showed clearly the presence of this body. This early stage was not seen in all the ovaries sectioned. The one in which it was seen was taken October 21, killed in osmic chromic acetic, stained in hæmatoxylin, cleared with clove oil and mounted in Canada Balsam The smallest egg in which the yolk nucleus was observed was 20 μ in diameter, *i. e.*, it was smaller than the largest egg in the ovary of the small fish 40 mm. in length, in which the yolk nucleus had not appeared. In these eggs of the adult fish the protoplasm around one side of the nucleus takes a deep stain. It appears as a crescent-shaped body, fitting very closely to one side of the nucleus and forming a kind of cap (Fig. 1, yk. nl). Another egg of the same measurement shows a little more advanced stage. The body is more definite in shape, not of so pronounced a crescent form and appears to have enlarged considerably (Fig 2, yk. nl.). The next important change is seen in a slightly larger egg, 25 μ in diameter (Fig. 3, yk. nl.). Here the body has assumed an oval form without any definite cell wall or hard outline. Although usually touching the nucleus it seems to have no further connection with it. In this egg it is quite large, measuring 10 μ in minor axis and 12½ μ in major axis. From this time the body seems to have severed its connection with the nucleus and during the remainder of the egg's immaturity gradually moves away from the nucleus From this fact and its early relation to the nucleus it seems evident that it must have originated from the nucleus But there is another more potent proof that this is its origin The largest eggs in the young fishes 17 mm 29 mm 35 mm and 40 mm in length measured as follows

Diameter of egg	35 μ	Diameter of nucleus	20 μ
	30 μ		17½ μ
	25 μ	"	15 μ

In other words the diameter of the nucleus is more than half the diameter of the egg It will be remembered that none of these eggs contained a yolk nucleus The smallest eggs in the adult fish containing a yolk nucleus measured as follows

Diameter of egg	20 μ	Diameter of nucleus	10 μ
	25 μ		12½ μ
	30 μ		15 μ

That is the nucleus has now been reduced to a diameter equal to one half that of the egg If this body originates from the nucleus as an extrusion of a part of its substance we should expect the nucleus to be relatively larger to the size of the egg before it appears than after its appearance This is exactly the case in these eggs (compare nucleus in Fig 1a and Fig 3) It will be seen from the two sets of measurements given above that in the eggs in which this body is not visible the diameter of the nucleus is always *more than half* that of the egg while in the eggs in which it is visible the diameter is *just half* that of the egg This relation is true in all the measurements I made

Take an egg with a diameter of 25 μ as a typical size of the smallest eggs in the adult fish and the largest in the small fish To simplify operations I have taken the number of divisions of the mikrometer instead of the absolute measurement of the egg Then the sizes of the eggs are expressed as follows

Diam of egg in adult fish	(*s*) 5	Diam of nucleus	2½
" small "	(*o*) 5	" "	3

The dark body (*e*) in the protoplasm of the egg being an oblate spheroid measures 2 in conjugate axis and 2 875 in tranverse axis

Now the solid contents of the nucleus in *o* ought to equal the solid contents of the nucleus *s*, plus the solid contents of the dark body *e* or $o = s + e$

Formula for contents of a sphere is $V = \frac{1}{6} \pi D^3$

" " " " oblate spheroid is $V = \frac{4}{3} \pi a^2 b$

V = volume

D = diameter

a = semi-transverse axis

b = semi conjugate axis

Substituting values in the formula for the sphere V of the nucleus of egg o = 14 1372 V of the nucleus of egg s = 8 18125 V of the dark body e (or the oblate spheroid) = 5 90704 + Therefore o (14 1372) = s (8 1825) + e (5 9070 +) leaving an error of only 049 which amounts to very little when considering that each division of the mikrometer only equals 003 mm and that the outlines of the dark body not being very definite it was difficult to get the precise measurement

I think this clearly proves that the body originates from the nucleus But I do not believe it is by ordinary cell division with the formation of a karyokinetic figure It seems to be a general extrusion of substance from the nucleus

It will be seen from an inspection of Figs 4 12 that this body is considerably smaller in these stages than in smaller eggs (Fig 1) Whether this is due to reagents causing a shrinkage or whether due to a condensation of substance I am unable to determine After the egg is 40 μ in size (Fig 5) at which time the body has reached its minimum size it continues to constantly increase through all of the other sizes It is nearly always irregular in shape and very seldom has a hard outline which might represent a cell wall

Sometimes it assumes very peculiar shapes (see Figs 7 9 10 13) The most aberrant form is represented in Fig 9 where it seems to have a long filament or tail which is only seen by careful focusing

Cymatogaster is viviparous The eggs of this fish ripen during the months of December January and February In an ovary taken on October 21 they range in size from 02 mm to 2 mm The eggs of November 2 begin to show signs of ripening (Fig 17 (*a*)) Here the nucleus a little eccentric The zona radiata is quite distinct and the follicle is well formed At this stage of maturity there is a peculiar circular region shaded much more darkly than the remainder of the vitellus This always appears on the side of the nucleus next to the yolk nucleus and opposite the point of the egg to which the nucleus seems to be moving The yolk nucleus under consideration is quite close to the periphery of the egg

November 30 some of the eggs become about ripe Fig 18 represents one which will probably be ripe in January In this egg the follicle is much developed the nucleus has become very eccentric and the yolk nucleus is nearly touching the periphery of the egg Up to this time the constant tendency of this body has been to become further and further removed from the nucleus towards the periphery of the egg

In the stages indicated by Figs 19 and 20* the body has become slightly changed in appearance These eggs are nearly ripe The nucleus has reached its limit of eccentricity, and in one stage (Fig 20) has lost its cell wall I have merely indicated its position, which is seen in another section The yolk is beginning to collect at the entodermic pole of the egg, *i e.*, around the yolk nucleus

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* These and succeeding figures are based on preparations made by Dr Eigenmann

In the ripe egg (Fig 21) the body in question is found surrounded by the yolk This egg was in the act of giving off the second polar globule The latter is not figured because seen in another section

After the egg is matured this body assumes many curious and interesting shapes (Figs 21 26) In Fig 21 the yolk nucleus seems to have broken into large granules several of them being grouped into a dark mass (yk nl) The whole region including the granules is somewhat shaded

After the egg has segmented into two cells the appearance is nearly the same as that just described except the granules are not quite so large and prominent (Fig 22) To this time the yolk nucleus has shown a granular structure but as I have represented in the remaining figures it looses that structure and appears to be homogeneous

In the stage represented in Fig 23 this yolk nucleus has entirely changed its appearance I did not have the sections to show the intermediate stages At this time the egg has segmented into 32–64 cells The yolk nucleus and its vicinity shows four different degrees of shading The centre of what seems to be the yolk nucleus proper is of a lighter shade than the margin which is quite dark Outside of this there is a still lighter shade than that within the body Beyond the last is another still less distinct

When the egg has segmented into many cells perhaps 600 (Fig 24) the yolk nucleus is larger and shows only one distinct shading

Fig 25 shows the greatest peculiarity of any Here the blastopore is nearly closed The body in question is somewhat pear shaped and has a few small vacuoles scattered through it It does not have such a distinctly granular structure but is of a uniformly dark shade It seems to form a kind of plug to the blastopore The lower edge of this body is marked by a distinct outline but the upper edge does not have such an outline For a considerable region in its vicinity there are different degrees of shading Also near the upper side there is a heavy shading which seems to consist of minute granules

After the closing of the blastopore (Fig 25) the yolk nucleus is much reduced in size the shadings have disappeared and there is seen only a number of granules The yolk also contains several similar granules scattered through it Here it seems evident the yolk nucleus has reached the final stage of disintegration It does not appear in any of the later stages of development I think that the different appearances this body presents after segmentation of the egg begins are due to the fact that it is in the process of disintegration The different depths of shading probably indicate the scattering of its substance through the yolk

This body seems always to be situated at or nearer the entodermic end of the pole of the egg Its position is constant during all its stages of growth It may be utilized in determining whether the axis of the egg has any definite and uniform relation to the axis of the ovary A compari son of the axis of eggs as determined by the position of the yolk nucleus shows that the axis of the egg has no uniform relation to the axis of the ovary

SUMMARY

1 This body originates from the nucleus in very small eggs in the adult soon after the cell becomes fully differentiated as an egg

2 It constantly moves from the nucleus towards the entodermic pole of the egg which it reaches when the egg is ripe

3 It is situated at the entodermic pole of the egg at maturity and during later stages

4 It is capable of growth condensing apparently when very young and then continuing to grow to considerable size

5 It is of definite chemical composition having great affinity for certain stains

6 It remains in the egg until the closing of the blastopore and then breaks up and disappears in the yolk

7 It is found in the eggs of many animals and has been figured as belonging to the spermatogonium or male cell See especially *Zeit fur Wissen Zool* Vol li Taf xxxvi also *Arkiv fur Mikro Anat* Vol xxxix, Taf xxi

The majority of papers on embryology which mention this body dismiss it without much comment However there are a few writers who attempt to explain its function in other animals The consensus of opinion seems to be that it is the centre of yolk formation But there is no direct evidence that such is the case It is mere speculation from the fact that it is found in the protoplasm of the egg before the yolk is formed In the eggs of Cymatogaster I have never seen any evidence that it gives rise to the yolk The yolk globules are scattered through the protoplasm seeming to appear equally in all parts of the egg As the yolk gradually forms it is homogeneously distributed in different sectors of the egg until maturation Then the yolk collects at the entodermic pole of the egg where the yolk nucleus has become located long before

The close association which this body has with the yolk would seem to indicate that it is in some way connected with it But how? I think in many of the eggs in which this body has been seen it is not at all functional But from the length of time it remains in the eggs of Cymatogaster and from the wonderful changes it undergoes in growth it would seem to be functional in this egg Dr Eigenmann has shown that these eggs mature very rapidly and hence have a small amount of yolk This fact may account for the yolk nucleus remaining so long after segmentation begins If the egg matured very slowly and allowed the formation of a large amount of yolk this body would probably disappear before the egg is ripe, as it does in other fishes

Another interesting question arises as to what determines its position exactly at the entodermic pole of the egg It seems to tend to that definite position when it first leaves the nucleus But without any question it takes up its station there before the nucleus begins to move towards the periphery of the egg as the nucleus always moves in a directly opposite direction from the body In all eggs the yolk collects at the entodermic pole of the egg Does this peculiar body serve as an attraction for the yolk in this egg? Or is it a mere coincidence that it is in the midst of the yolk and has no particular connection with it?

In conclusion I would say that I cannot definitely determine its function I think the body is homologous with the meganucleus in protozoans It is the vegetative portion of the egg given off from the nucleus when the egg cell has become fully differentiated as such That which remains of the nucleus is homologous with the micronucleus in protozoans It is the animal part of the egg which is further concerned wholly with the reproduction of the species

HISTORICAL REVIEW OF THE LITERATURE ON THE YOLK NUCLEUS

Hoffman (78 p 545) in his studies on the young ovarian eggs of amphibians saw the yolk nucleus in *Rana esculenta* He merely mentions it and describes it as a round dark, granular body within the yolk He says it is not seen in all amphibians

Balbiani (79) has had some very peculiar views on the origin of this body His ideas being now so untenable I quote this more as a curiosity than as shedding any light on the true origin He considers the follicular cells as homologous to the spermatoblasts The yolk nucleus corresponds to the spermatic elements One becoming free from the follicle penetrates the yolk When it first enters it leaves a sort of canal behind it which is soon closed up by the surrounding yolk It is a sort of spermatozoid and partially fertilizes the egg preliminary to the true fertilization which takes place later In parthenogenetic eggs this body would perform the function of the male element If his descriptions are based on facts the body he described is not homologous with the yolk nucleus of authors in general

Schafer ('80) describes and figures this body in the eggs of the rabbit He thinks he saw some connection between the nucleus and the yolk nucleus He believes that the latter is derived from the former, but not by a process of ordinary cell division

Schutz (83) has given an extended review of this body as seen in various classes of animals But he seems to have no adequate conception either of its origin, function or fate He remarks that the yolk may have produced it and that it later serves as nutrition for the yolk The observations were made on isolated specimens of fresh eggs No sections were made nor was the body traced out in any single species He has, however, carefully compiled a large list of animals in which it has been seen, and has described its structure and appearance in many of them His refer ences to the literature on the subject is extensive, but, much of it being inaccessible to me, I have made no note of what I could not personally examine.

Van Bambeke ('83) studied this body in the eggs of *Leuciscus rutilus* and *Rhodeus amarus*. He says very little as to its origin, but thinks it may come from the nucleus. His figures show it to be connected with the nucleus by a funnel shaped tube, the large end of which encloses the nucleus and the small end touches the yolk nucleus. From this appearance it would seem to be connected in some way with the nucleus. He seems to think this body is the centre of the yolk elements.

Balbiani ('83, p 676) found this body in the eggs of *Geophiles*. In these eggs the nucleus sends out prolongations. These break off close to the nucleus and in turn they break up into large granules. These take a deep stain. These granules, he thought afterwards, left the vitellus and became the cells of the follicle. In this theory he was supported by Fol, Roule and Sabatier. There was one granule, however, that became differentiated from the others, and instead of forming a cell of the follicle remained in the vitellus and became what is known as the yolk nucleus. He thought its function was to originate the yolk. He says "The first granulations of yolk are produced on the surface of this body and afterwards distribute themselves to all parts of the egg." In some animals he finds lines radiating in all directions from this body. Forming the limit to these radiating lines are concentric layers of substance.

Balfour ('85, pp 21, 50) describes the yolk nucleus as seen in *Araneina* by Ludwig and others. He says it always disappears before development commences. He remarks that it is probably connected in some way with the nutrition of the ovum. This body is not found in all genera of *Araneina*.

Haeker ('92, p 251) having studied this body in *Aequorea forskalea* calls it the metanucleolus. In the ovarian eggs it was present within the nucleus as the nucleolus. One half hour after being laid the nucleus appeared to extrude this body. He traced the body in the blastomeres until a late stage in cleavage. The author thinks homologous structures have been seen in other Medusæ. He considers the paracopulation cells of Daphnids described by Weismann and Ishikawa as homologous with the metanucleus of Medusæ. Haeker did not observe any division or any radial arrangement of protoplasm around this body.

Monticelli ('92) has studied this structure in the ova of *Distomum veliporum* and *D. richiardii*. He concludes that the vitelline nucleus is a cytoplasmic product, a nutritive differentiation probably acting as a centre in the formation of yolk.

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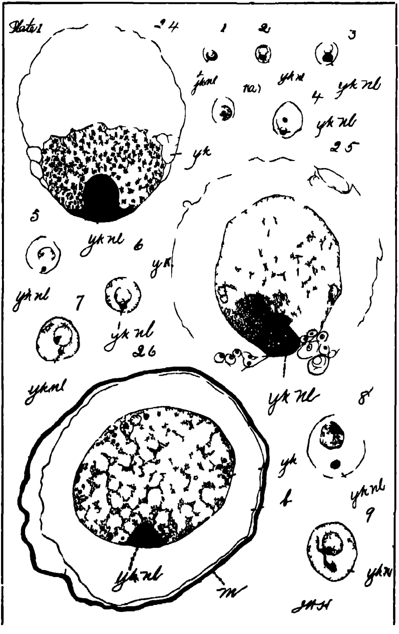
Plate 1
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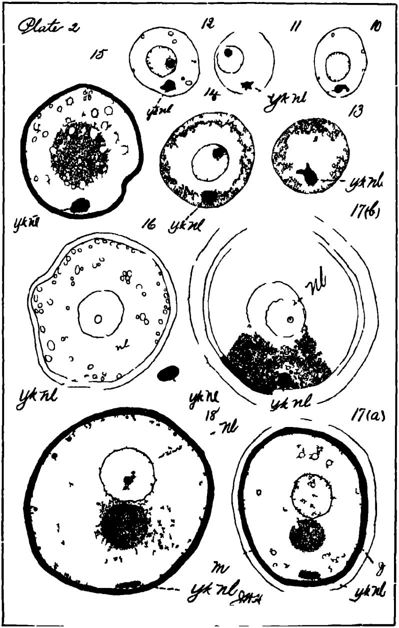
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Plate 3

Fig 19

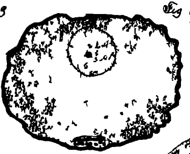


Fig 20

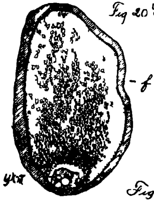


Fig 21

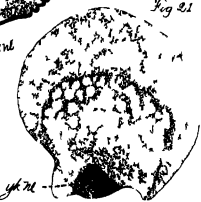


Fig 22

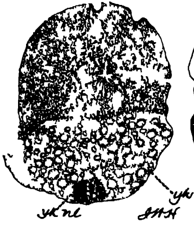
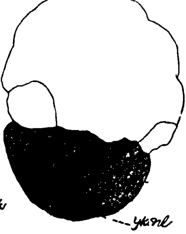


Fig 23



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EXPLANATION OF FIGURES

Abbreviations

b—blastoderm
f—follicle
m—egg membrane — zona radiata
nl—nucleus
yk—yolk
s—zona radiata
yk nl —yolk nucleus

All the figures were drawn with the Abbe camera and Zeiss D and 4 / x 320

Figs 1–9 and 24–26 inclusive are found on Plate I
10–18 inclusive are found on Plate II
" 19–23 III

Fig 1 First appearance of yolk nucleus in smallest eggs
1(*a*) Nucleus before extrusion of yolk nucleus
2 3 Successive stages of growth
" 4 Yolk nucleus much reduced in size
" 5–16 Successive changes in appearance and growth of the yolk nucleus
(All of the above eggs stained in hæmatoxylin)
" 17(*a*) 18 Stained in eosin
" 19 Egg near the time of maturation
Fig 20 A little latter stage than that of Fig 19
" 21 A ripe egg Yolk collected at entodermic pole of the egg
" 22 Egg segmented into 2 cells
" 23 " " 32–64 cells
" 24 " " " many cells, probably 600
" 25 Late stage in segmentation Blastopore nearly closed
" 26 Blastopore closed. Yolk nucleus somewhat scattered through the yolk.

On the Fishes obtained by the Naturalist Expedition in Rio Grande do Sul

By E D Cope

(Read before the American Philosophical Society January 5 1894)

The fishes of the Brazilian province of Rio Grande do Sul have been locally studied by Hensel (1868 70) and Von Jhring (1893) so that they are better known than those of some other parts of South America The latest enumeration that of Von Jhring includes forty nine species The present report includes forty one species of which twenty are not found in Von Jhring s list Perhaps three of these are enumerated by that author under different names so that this paper adds perhaps seventeen species bringing the whole number to sixty six species The number of species in Von Jhring s list which I have not found in this collection is thirty This wide diversity in the collections is probably due to the fact that those studied by Hensel and Von Jhring were made much nearer the coast while my collection was obtained in the interior near the mountains The absence of various species of the lower and tide waters from my collection together with the presence of species of the smaller streams may be thus accounted for A summary of the results will be given at the end of the paper

The collection now reported on was made by Mr H H Smith, who was sent to Brazil in the interest of the *American Naturalist* A report on the Mammals was made in that periodical in the year 1889 and reports on the Reptiles and Batrachia have been published in the *Proceedings* of this Society for 1884 and 1887

PLECTOSPONDYLI

CHARACINIDÆ

MACRODON TAREIRA Bl and Schn

Authors who think, with the American Ornithologists' Union, that scientific nomenclature may record error instead of truth, call this well known South American species ***Macrodon malabaricus*** because Bloch described it first under that name, under the mistaken idea that it was a native of India

XIPHORHAMPHUS BRACHYCEPHALUS sp nov

Teeth of the maxillary bone small, equal Head short, body deep, scales large Depth of body entering length without caudal fin, three times, length of head in the same four times Scales $\begin{matrix}10\\54\\6\end{matrix}$ Fin radii, D 11, A 27 Muzzle short, entering length of head 8 5 times, diameter of eye entering the same four times, interorbital space convex, its width entering length of head 8 5 times, hence equal length of muzzle The profile is slightly descending and nearly straight The

extremity of the maxillary bone is in line with the posterior border of the orbit The pectoral fin reaches the base of the ventral but the ventral does not quite reach the anal

The color is silver with greenish and bluish reflections A large black spot at the base of the caudal and a smaller one behind the epiclavicle No lateral band

Total length 177 mm length to base of caudal fin 145 mm length to base of anal 89 mm length to base of ventral 63 mm length of head 87 mm

This species is near the *X hepsetus* Cuv From the full description and figures given by Steindachner * we learn that in that species both the body and head are of more slender proportions at all ages and that the interorbital diameter is relatively narrower It possesses also a silver lateral band which terminates in a black stripe on the caudal peduncle and fin The scale and ray formulæ are the same in the two species

The *X jenynsii* Gthr was thought by Steindachner to be identical with the X *hepsetus* but he subsequently concluded that it is distinct (see *Sitz ber Wien Akad* 1891 p 371) It is evidently very near the latter and has a more slender form of head and body than the *X brachycephalus* The depth enters the length according to Steindachner 3 3 to 3 5 times and the length of head enters the length 8 5 to 8 6 times The interorbital width is less entering the length of the head 4 to 4 5 times Scales of lateral line 56 62

Two specimens

XIPHORHAMPHUS HEPSETUS Cuv Steind *l c*

Two specimens The smaller measuring 170 mm agrees with Steindachner s description but the larger 215 mm differs in exceeding the proportions given as characteristic of old individuals Thus the scale formula is $\frac{\overset{17}{76}}{8}$ the highest figures given by Steindachner being $\frac{14}{\underset{7}{70}}$ The eye enters the total length of the head 5 5 times the highest relative proportions of Steindachner s description being 4 66 times In both specimens the length of the head exceeds the depth of the body

ASIPHONICHTHYS STENOPTERUS Cope, *Amer Naturalist* 1894 p 67

Char gen—Subfamily Hydrocyoninæ Teeth on premaxillary maxillary and dentary bones the first in two series the last in one those of both of unequal lengths Dorsal fin short above the anterior rays of the long anal No lateral line of pores, except on a few anterior scales, Gill rakers lanceolate

This genus is Anacyrtus without a lateral line of pores

Char specif—Dorsal outline elevated profile of cranium concave mouth directed obliquely upwards Scales 49, 20 Fin radii D 11 A 46, the anterior three shorter , V 9 P 15 Depth of body 2 66 times in length without caudal fin Length of head 3 8 times in the same Eye three times in head exceeding length of muzzle and equal interorbital width Dorsal fin elevated narrow pectorals narrow, covering basal third of ventrals ventrals lanciform reaching fourth anal ray Color silvery with an ill-defined silver lateral band An obscure postclavicular dark spot, and some obscure dark dots on the silver lateral band No basal caudal spot

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* *Sitzungsber K Wien Akad Wiss* Nov 1876 p 55

Length to end of middle caudal radii 80 mm length to base of caudal fin 72 mm length to base of anal (oblique) 35 mm length to base of ventrals 26 mm length of head 20 mm

A single specimen from the Jacuhy Besides the generic characters, the scales are larger than in the known species of Anacyrtus

CHORIMYCTERUS TENUIS Cope, *Amer Naturalist* 1894 p 67

Char gen —Denticulate teeth on intermaxillary and dentary bones, and in a single row on the former On the dentary bone a second interior series of simple teeth Dorsal and anal fins short, the former commencing in front of the base of the latter Nares separated by a wide space Lateral line complete

This genus is near to Characidium but differs in having two series of mandibular teeth From Piabucina it differs in the separated nostrils and the presence of a lateral line

Char specif —Form slender the depth contained seven times in the length less the caudal fin Profile of muzzle decurved mouth small the end of the maxillary nearly reaching the anterior margin of the orbit Eye large, oval contained in the length of the head three times and as wide as the interorbital space opposite its posterior border Teeth of both jaws rather elongate, with a single lateral denticle on each side of and near the acute apex Length of head five times in total length without caudal fin Scale $\overset{8}{\underset{4}{39}}$ Fin radii, D 11 A 9, V 9 P 19 Pectorals elongate not reaching ventrals, ventrals reaching about half way to anal Caudal fin deeply emarginate Color silvery, most brightly on the suborbital and opercular regions Scales with slightly shaded borders

Total length 66 mm , length to base of caudal fin, 55 mm length to base of anal, 41 mm length to base of ventral, 27 mm , length to base of dorsal, 22 mm , length of head 11 mm

This fish is more slender than the *Characidium fasciatum* of Reinhardt, and has a different scale formula and coloration It is still more slender than the *C etheostoma* Cope, and *C steindachneri* Cope

PSEUDOCORYNOPOMA DORIÆ Perugia, *Ann Mus Genoa*, x, 1891, 646
Bergia altipinnis Steind , *Sitzber K. Akad Wien*, 1891, 336

Char gen —Dorsal fin originating above the anterior part of the elongate anal fin Denticulate teeth on the premaxillary and dentary bones, in two series on the former and one series on the latter no canines Nares close together Pectoral and ventral regions compressed acute Lateral line straight continuous Ventral fins small Gill rakers lanceolate

This genus is allied to Gasteropelecus but the lateral line is of the normal type that is straight and continuous From Piabucina it differs in having two series of premaxillary teeth and from Chalcinus in the absence of conical teeth between the dentary series It is an interesting form connecting Gasteropelecus with Chalcinus

Char specif —General form rhombic the profile straight from the base of the dorsal fin to the extremity of the muzzle Mouth opening obliquely upwards Pectoroventral outline moderately and not extremely convex Pectoral fin elongate falcate reaching anal ventral not reaching anal Scales $\frac{7}{40}{6}$ Fin radii D 1 10 A 37 V 7 P 13 Anterior rays of dorsal and anal fins in probably male individuals produced the former reaching the base of the caudal The caudal deeply emarginate Depth entering length 2 6 times, length of head entering same four times Diameter of eye entering length of head (without chin) three times and entering the interorbital width 1 25 times General color silvery a whiter silver band extending from near the epiclavicular region to the base of the caudal fin above the lateral line No dark markings

Total length 67 mm length to base of caudal fin 52 mm length to base of anal (oblique) 34 mm length to base of dorsal (oblique) 32 mm length to base of ventral 25 mm length to base of pectoral 15 mm length of head 13 5 mm

This is apparently an abundant species in the Jacuhy My specimens agree with those described by Steindachner from Montevideo except that in the latter the eye is a little smaller entering the length of the head 3½ times and there are 40–1 anal rays The *P argentinum* Holmb from the Plata (*Revista Argentina* 1891 p 190) is to judge from the description, a more slender fish with the lateral line nearer the dorsal border

TETRAGONOPTERUS RUTILUS Jenyns Steindachner *Sitzungsber Wien Akad Wiss*, November 1876 p 17

The five species of Tetragonopterus represented in the collection may be distinguished synoptically as follows

a No teeth on the maxillary bone

Scales of lateral line, 40, anal rays 28 eyes ⅓ head, equal interorbital space elongate . *T rutilus*

Scales of l l 36 anal rays, 28 eye, ¼ head, 1½ interorbital space orbicular *T jacuhiensis*

Lateral line, 32-3, anal rays, 23, eye, 2 5, equal interorbital space rhombic . . . *T eigenmanniorum*

Lateral line 37 anal rays 20 head thick eye 3½ 1½ in interorbital elongate *T laticeps*

aa Teeth on the base of the maxillary bone

Lateral line 35 anal rays 19 eye large 2½ in head equal interorbital elongate no spots *T pliodus*

In the *T rutilus* the form is rather elongate the depth entering the length (minus caudal fin) 2 60 times while the head is short entering the length 4 5 times The eye is large entering the length of the head three times and equalling the width of the convex interorbital space The maxillary is toothless and reaches the vertical line of the anterior border of the orbit The muzzle is as long as three quarters the diameter of the eye Scale formula $\overset{7}{\underset{6\frac{1}{2}}{40}}$ Radii D 11 A 28 V 7 with a lanceolate scale at axilla The pectoral reaches the base of the ventral but the ventral does not reach the anal Origin of dorsal a little posterior to that of ventral The color is yellow silvery whiter on the middle of the sides Humeral and caudal spots obscure the former not visible in some specimens apparently vertical where obscurely visible Median caudal rays black

Total length 135 mm length to base of caudal 110 mm length to base of anal 70 mm length to base of ventral (oblique) 50 mm length of head 24 mm

The specimens agree in the main with Steindachner's description * although the number of scales of the lateral line is a little greater than is given by him In outline of body our specimens are most like his elongated variety (Pl II Fig 3) but the head is shorter since in the variety the head enters the length four times instead of 4 5 times

A few specimens

TETRAGONOPTERUS JACUHIENSIS sp nov

The deepest bodied species of the Jacuhy, rather deeper than the *T maculatus* of Cuvier The depth enters the length less the caudal fin 2 25 times and the length of the head enters the same four times The eye is rather small entering the length of the head four times while the interorbital space is 1 5 times its diameter The profile of the head is slightly concave and those of the back and belly are about equally convex Scales $\overset{6\text{–}8}{\underset{6\frac{1}{2}}{38}}$ Radii D 11, A 27–8 V 8 with axillary scale First dorsal ray a little posterior to first ventral ray Color silvery with steel blue reflections Humeral and basal caudal spots conspicuous the former subround and situated in the centre of a pale area, which is bounded posteriorly by a vertical curved black border, sometimes indistinct Caudal spot continued on middle caudal rays

Total length, 114 mm , length to base of caudal fin, 95 mm length to base of anal 63 mm length to base of ventral (oblique) on 45 mm length of head 23 mm

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* *Sitzungsber A Wien Akad* November 1875 p 17

This species is allied to the *T maculatus* Linn but that species has a larger eye (one third head) and a longer anal fin (32 8 rays) *

The number of rays is so constant in numerous specimens that if Steindachner s figures are correct which there is no reason to doubt this form must be distinct The *T maculatus* is ascribed by both Boulenger and Von Jhring to Rio Grande do Sul

The proximal part of the maxillary bone is minutely serrate but not dentate

Fifteen specimens

TETRAGONOPTERUS EIGENMANNIORUM sp nov

A species of rhombic form differing from those above described in the smaller number of anal radii and fewer scales of the lateral line Depth entering length without caudal fin two and a half times length of head in the same 3 4 times Eye large longer than muzzle entering head three times and equal interorbital width Scales $\frac{7}{\overline{}\,6}$ Radii D 11 A 23 Ventral commencing a little anterior to first dorsal ray not reaching anal Pectoral reaching ventral Profile of head very slightly concave Dorsal and ventral profiles subsequently arched Color silvery with a whiter silvery lateral band No humeral nor distinct caudal spot Middle caudal rays dusky

Total length 67 mm length to base of caudal fin 53 mm length to base of anal 33 mm length to base of ventral (oblique) 26 mm length of head 15 mm

But one specimen presents exactly the typical characters of this species but five others probably belong to it They have a few more scales of the lateral line as 33–4 and one has 36 They have a basal caudal spot, and four of them show traces of the humeral spot and have a steel blue reflection as in the *T jacuhiensis* The small number of the anal rays 23 4 distinguishes it from the latter, where there are always 27–8 and the form is more elongate

This species is dedicated to Prof and Mrs C H Eigenmann of the University of Indiana whose work on the fishes of South America has so elucidated the subject

TETRAGONOPTERUS LATICEPS sp nov

Form elongate oval, depth entering length (without caudal fin) 2 6 times length of head into same 3 75–4 times Profile of back descending regularly from dorsal fin, of front straight or slightly concave Diameter of eye greater than length of muzzle, entering 3 to 3 3 times in length of head Front slightly convex transversely wider than diame ter of eye and entering length of head 2 33 to 2 5 times Scales $\begin{matrix}6\\37\\4\frac{1}{2}\end{matrix}$ Radii D 11 A 20 Pectoral fin reaching base of ventral ventral not reaching anal No denticulations on maxillary bone Color silvery a silver lateral stripe with humeral and caudal spots The humeral spot is subround and the caudal extends to the end of the median caudal rays

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* Teste Steindachner *l c* p 10

Total length 74 mm length to base of caudal fin 60 mm length to first anal ray 40 mm length to base of ventral (oblique) 28 mm length of head 16 mm

Eighteen specimens of this species are before me It is allied to the *T fasciatus* Cuv *T brevimanus* Gunther and *T jenynsii* Steindachner The body is deeper than in the first named and the frontal region is wider the muzzle is shorter and the maxillary bone is not denticulate From *T brevimanus* it differs in the deeper body larger eye and longer pectoral fin The *T jenynsii* has a narrower front only 33 scales of the lateral line and the humeral spot a vertical bar According to Steindachner s figure the dorsal outline descends towards the dorsal fin In *T laticeps* it rises to that fin I would have suspected that this species might be the *T iheringii* of Boulenger but one of the principal characters of that species as well as of the *T alburnus* of Hensel is that it has but 10 dorsal radii The *T obscurus* Hens has the interorbital diameter equal the eye and a vertical humeral spot

TETRAGONOPTERUS PLIODUS sp nov

Form rather elongate depth entering length (less caudal fin) three times length of head entering the same four times Maxillary bone extending beyond anterior border of orbit supporting several tridenticulate teeth on its proximal portion Eye large, much exceeding muzzle, entering length of head 2 23 times and a little exceeding the interorbital width Scales $\frac{\frac{4}{35}}{4}$ Radii D 10, A 19 V 9 Pectorals not reaching ventrals nor ventrals the anal fin Dorsal originating a little posterior to line of origin of ventrals Silvery with a broad distinct, silver lateral band No spots of any kind

Total length 70 mm , length to base of caudal fin 57 mm length to base of anal 33 mm length to base of ventral (oblique), 26 mm , length of head 18 mm

This is apparently a rare species only two individuals being contained in the collection It has many peculiarities one of which is the possession of only ten rays in the dorsal fin It shares this character with the *T alburnus* of Hensel from the same region but this species has 27 rays in the anal fin and the body is more elongate It has some points in common with the *T iheringii* (Boulenger, *Amer Magas Nat Hist* 1891, p 172) Boulenger does not mention the maxillary teeth which he could scarcely have overlooked It has also one or two additional rows of scales above the lateral line and has the humeral and caudal spots which are wanting in the *T pliodus*

HEMIGRAMMUS LUETKENII Boul *Tetragonopterus luetkenii* Boulenger *Ann Mag Nat Hist* 1891 p 173 *Chirodon luetkenii* von Ihring *Susswass Fische v Rio Grande do Sul* 1893 p 22

Form deep ovate outlines of body equally convex Profile of front straight a slight concavity above line of preopercle Depth of body into length (less caudal fin) two and a half times length of head into the same four times Eye large its diameter greater than length of muzzle a little less than interorbital width and entering length of head 2 8 times

Scales, $\begin{matrix}5\frac{1}{2}\\3\\4\frac{1}{2}\end{matrix}$ Radii D 11 A 23 Pectorals not reaching ventrals and ventrals not reaching anal No teeth on the maxillary bone Tubes of lateral line on eight to twelve scales Dorsal fin originating a little behind vertical line of origin of ventrals Color silvery a silver band on side Humeral spot large distinct subround caudal spot distinct extending to extremities of median caudal radii

Total length 76 mm length without caudal fin 60 mm length to origin of anal 40 mm length to origin of ventral (oblique) 29 mm length of head 10 mm

This species differs from the *H robustulus* Cope in its more compressed head and in the absence of teeth on the maxillary bone An abundant species in the Jacuhy

CHIRODON MONODON sp nov

A single crenate tooth on the proximal extremity of the maxillary bone General form rhombic oval Depth in length less caudal fin 2 6 times length of head in the same 3 6 times Eye large its diameter exceeding length of muzzle equaling interorbital width and entering length of head 3 times Scales $\dfrac{\overset{5}{3}}{4\frac{1}{2}}$ Radii, D 10 A 19–23 Pectoral reaching ventral and ventral nearly reaching anal Origin of dorsal a little posterior to that of ventral Lateral line extending on 9–10 scales Silvery an indistinct narrow dusky line visible on the middle of the side from the caudal fin to below the dorsal

Total length 46 mm length to base of caudal fin 35 mm length to base of anal 23 mm length to base of ventral 15 mm length of head 9 mm

This small species has a scale formula about as in the *Hemigrammus ihringii*, but there is but one series of premaxillary teeth there is a tooth on the base of the maxillary bone and there are only ten dorsal rays The number of anal rays is somewhat variable Of the three specimens, one has 19 rays the second 20, and the third 23 This is a deeper bodied form than the *C pisciculus* Gird , and the only other spe cles *O interruptus* Jon is said to have 11 dorsal rays and no maxillary teeth

DIAPOMA SPECULIFERUM *Amer Naturalist* 1894 p 67

Char gen —Adipose fin present Dentition as in Tetragonopterus i e with two rows of denticulate teeth on the premaxillary bone and one row on the dentaries Origin of the short dorsal fin entirely posterior to that of the ventrals Anal fin elongate Belly not keeled The operculum produced posteriorly below the lateral line to an apex Lateral line not complete Nares close together Inferior limb of external branchial arch without rakers

This genus is allied to Hemigrammus but has a peculiarly formed operculum which displays a tendency towards the character which is so much developed in Corynopoma Gill *

Char specif —Form rather elongate the depth entering the length 3 25 times (less caudal fin) Length of head entering the same 3 6 times Maxillary bone elongate reaching the line of the anterior border of the pupil supporting 4–5 teeth at its proximal end Eye large its diameter exceeding the length of the muzzle equaling interorbital width and entering length of head three times one diameter equaling the long horizontal diameter of the operculum and suboperculum The latter two elements form a subtriangular plate of which the long diameter is horizontal and of which the base is continued as a process along the posterior border of the preoperculum The apex of the triangle is formed by the extremity of the suboperculum and is obtuse Scales, $\overset{4}{\underset{5}{37}}$, lateral line pores and tubes present on ten scales behind the epiclavicle and on eight scales anterior to the caudal fin Radii D 1 9 A 2 29, V 7 P 11 Pectorals just reaching ventrals and ventrals not reaching anal Caudal deeply emarginate, a curved patch of scales extending on the inferior lobe from the base Anal fin with its free border concave, the anterior rays longer than the posterior and the posterior longer than the middle rays

Sides excepting the dorsal portion and that part adjacent to the anal fin, with a mercury like metallic surface, the operculum most brilliantly refulgent the cheeks little less so A straight leaden line from the head to the base of the caudal fin No spots

Total length 43 mm length to base of caudal fin, 36 mm, length to base of anal, 23 mm length to base of ventrals, 17 mm, length of head 10 mm length of head to preoperculum 6 mm

But one specimen of this curious little fish was sent by Mr Smith It is the most brilliant of the Characinidæ known to me

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*This genus received several names from Prof Gill at the same time Of these Dr Günther selected Corynopoma as he had a right to do and he has been followed in this by most other ichthyologists One of the other names cannot therefore be now selected for this genus because it was printed on a previous page as has been recently proposed

CURIMATUS GILBERTII Q and G

Numerous specimens

STERNOPYGIDÆ

CARAPUS FASCIATUS Pallas

STERNOPYGUS VIRESCENS Val

Apparently abundant

NEMATOGNATHI

SILURIDÆ

RHAMDIA SAPO Val

Five specimens which agree with the description given by the Eigenmanns except in the possession of narrower bands of premaxillary and dentary teeth The premaxillary patch is five times as long as wide

RHAMDELLA STRAMINEA sp nov

Surface of posterior cranial bones fossate but covered with a thin skin Fontanel reaching base of supraoccipital process with a narrow bridge opposite the posterior border of the orbit Adipose fin entering the length (to base of caudal) five times and equal to depth of body length of head entering total four times Upper lip projecting a little beyond lower tooth band in both jaws wide teeth well developed Eye 4 times in length of head to angle of operculum one and a third times in interorbital width and one and a half times in length of muzzle Centre of pupil nearer end of muzzle than opercular angle Maxillary barbels reaching middle of ventral fins external mentals reaching base of pectoral fins, middle mentals half as long as externals Dorsal spine rather slender elongate, toothless, pectoral spine more robust longer than soft rays with eight robust spines on its internal border, and more numerous smaller dentations on the anterior border, which are not recurved Radii D I 6 A 18 P I 8 Caudal fin deeply emarginate the superior lobe a little longer than the inferior

Total length, 83 mm, length to base of caudal fin 68 mm length to base of anal, 50 mm, length to base of ventral, 33 mm length to base of pectoral, 19 mm Length of head to apex of supraoccipital process, 21 mm

Color in spirits brownish straw color, with silvery opercle, rather sparsely dusted with black specks Adipose fin dusky bordered

Five specimens of this species, which approaches the *R jenynsii* Gthr according to the detailed description given by the Eigenmanns That species is said to have the eye only one fifth the length of the head, and the adipose fin is one fourth the total length The occipital process is said to be covered with a thick skin In the *R straminea* this process is rugose and is covered by a very thin skin, and approaches quite near to the dorsal plate From the *R eriarcha* E and E, from the Uruguay river this species differs in the proportions of the eye and head the much longer barbels much shorter adipose fin etc

PIMELODUS NIGRIBARBIS Blgr *Proceeds Zool Soc* London 1891 p 232 Pl xxv Fig 1

Several specimens

LORICARIA CADEÆ Hensel *Archiv f Naturgesch* 1868 p 369

Represented by four specimens of rather small size The muzzle is depressed and is acuminate when viewed from above and its length from the orbit enters the length of the head to the posterior extremity of the occipital plate two and a half times The edges of the muzzle are hispid but not bristly The abdomen is covered with a continuous series of scales of which the lateral are elongate and directed forward and the median smaller and in two rows Those between the ventrals are distinct but solidly united and there is a single anal which is notched in front for the anus The scuti of the nape are furnished with obtuse keels one on each side which form a pair of ridges which converge forwards and are continued on the occipital plate until they approach quite closely They then diverge and terminate above the postorbital plate The third median nuchal plate is not ridged but a lateral plate which joins it and the second nuchal on each side has a keel There is no keel posterior to this nor any between it and the superior keel of the lateral line The space between the nostrils forms a median narrow ridge which bifurcates posteriorly each half disappearing above the middle of the supraorbital border from which it is separated by a groove which is a posterior continuation from the nareal fossa The central premaxillary ridge is divided by a narrow median groove and a shallow groove bounds the lateral plates on each side terminating in a preorbital fossa Scales of lateral line 28–29 the lateral keels uniting on the eighteenth scale Diameter of eye without the shallow notch entering length of head 5 5 times and interorbital width 1 25 times

The length of the head to the end of the occipital plate enters the length (less the caudal fin) 5 25 times and the width of the head enters its length 1 4 times the depth of the head enters the length of the same twice Premaxillary jaws not separated by an emargination but firmly united Teeth $\frac{4}{4}$ Lips coarsely and shortly fringed all round the posterior coarsely tubercular and not notched posteriorly Beard shorter than diameter of eye The dorsal spine enters the total length (less caudal fin) 4 25 times and the anal spine enters the same 5 6 times Radii, D I 7 P I 6 V I 5 A I 5 The pectoral fins just reach the ventrals and the ventrals the anal The marginal rays of the caudal are not stronger than those of the other fins Its border is concave, and the superior apex is a little longer than the inferior, and it is without filamentous prolongation

Color light brown above, yellowish below Five brown cross-bands on the dorsal region and one on the nape Five obscure dusky spots on the lateral border of the head to the opercular fissure Dorsal fin with a dark spot near the extremity Caudal with a dark spot at each apex and two at the base Anal ventrals and pectorals dusky at the extremity

Total length 78 mm length to base of caudal fin 66 mm length to base of anal fin 31 mm length to base of ventral 21 mm length to base of pectoral 11 mm length to end of occipital plate 15 mm

The only species which it is necessary to compare with this one is the *Loricaria konopickyi* of Steindachner * According to this author this species resembles the *L cadea* in most essential respects It has however two lines of keels between the dorsal spine and the lateral ridge where none exist in the *L cadea* and the middle rows of abdominal scales are in five rows instead of three The teeth are nine or ten instead of six or seven and the keels of the lateral scales come together on the fifteenth instead of the eighteenth row The muzzle enters the head length 2 5 times instead of twice The *L konopickyi* is from the Amazon basin

Loricaria lima Kner to which this species is referred as identical by Von Jhring differs as follows The head enters the length 4 66 times the superior ray of the caudal fin is produced the eye enters the head 7 5 times the fins are spotted

LORICARIA SPIXII Steindachner *Denkschr Wien Akad Wiss* 1881 18 Pl ii Several specimens

HISONOTUS LÆVIOR sp nov

Form rather slender the depth at the base of the first dorsal ray entering the length to base of tail six times and equalling the length of the muzzle anterior to the orbit Eye small entering length of head five times and three and a half times in the nearly flat interorbital space Venter not entirely covered with scales there being a series on each side and a row of smaller ones in the middle separated from them by a naked space Median series expanding into a shield just posterior to bases of ventral fins Dorsal and ventral aspects of caudal region rounded Scales posteriorly moderately hispid smoother anteriorly on the top of the head the prickles very small Lower lip convex with narrow margin and coarsely tubercular surface

Origin of dorsal fin a little posterior to line of origin of ventrals Caudal fin with the inferior angle produced a little farther than the superior Spines of fins only moderately hispid except towards the extremities of the pectorals where the prickles are coarser Radii D I 7 P I 7 V I 5 A I 5 Scales of lateral line, twenty eight The pectoral fins reach the middle of the length of the ventrals, but the latter do not reach the anal

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* *Denkschriften math Wiss Klass Kais Akademie d Wissensch* 1879 p 45 Pl vi Fig 3 and Pl vii Fig 1

Color light brown The dorsal fin is sparsely and the caudal fin is closely spotted with blackish and the spinous rays of both are light colored with dusky spots

Total length 52 mm length to basis of caudal fin 41 mm length to base of anal 25 mm length to base of ventrals 16 mm length to line connecting bases of pectorals 10 mm

A single specimen from the Rio Jacuhy Rio Grande do Sul

This is the third species of the genus now known the one first described being the *H notatus* of Eigenmann * This species is said to be characterized by the presence of a triangular posterior process of the occipital element and by the compressed and elevated form of the head characters not seen in the present species The orbit is smaller but the interorbital space is only as wide as three of its diameters It has only twenty five plates of the lateral line The *Hisonotus nigricauda* † of Boulenger differs in the twenty five plates of the lateral line the I 5 pectoral rays the more numerous rows of ventral plates and the larger eye

HISONOTUS LEPTOCHILUS sp nov

Form rather slender head rather depressed Depth at first dorsal ray entering length to base of caudal fin 5 5 times Eye small entering length of head 5 5 times and three times on the rather flat interorbital space Venter covered with from ten to twelve rows of scuta a single row on each side anteriorly larger than the others Caudal region rounded above and below Hispid everywhere especially on the supertemporal region Three transverse and a median rhombic scuta between the occipal scute and the base of the dorsal spine Lower lip thin with thin transverse posterior margin and inconspicuous tubercles

Dorsal fin originating a little posterior to ventrals Pectorals reaching middle of ventrals ventrals barely reaching anal Inferior angle of caudal fin a little longer than the superior Radii, D I 7 P I 6 V I 5 A I 5 Scales of lateral line 29

General color dusky with numerous small pale spots everywhere most conspicuous when the fish is immersed in fluid Fins lighter conspicuously spotted with dusky

Total length 54 mm length to base of caudal fin 41 mm length to base of anal 83 5 mm length to base of ventrals 17 5 mm length to base of pectorals 10 mm interorbital width 6 mm

The important characters which distinguish this species from the *H laevior* are the thin and truncate lower lip with feeble tuberculation, the numerous ventral plates the narrower interorbital space and the greater hispidity especially of the head It differs from the *H notatus* in much the same way as the *H laevior*

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* Revision of South American Nematognathi *California Acad* Sciences 1890 p 391.

† *Proceeds Zool Soc* London 1891 p 234

HISONOTUS NIGRICAUDA Boulenger *Otocinclus nigricauda*, Boul., *Proceeds Zool Soc*, London, 1891, p 234, Pl xxv, Fig 3

One specimen This species differs from those described above, in the presence of only two nuchal scuta between the occipital bone and the base of the first dorsal ray, as represented in Boulenger's figure In this point it agrees with the two species of Otocinclus to be described below In the two species of Hisonotus referred to, there are four nuchal plates crossing the same space

The specimen of *H nigricauda* measures, only 30 mm The sides and posterior two thirds of the middle line of the belly are squamous, the remainder smooth

OTOCINCLUS FLEXILIS sp. nov.

Head large, muzzle rather short, width posteriorly equal depth of body at first dorsal spine, and entering the length less the caudal fin four and a quarter times Eye entering length of head four times, and interorbital width three times Body compressed, superior and inferior aspects of caudal peduncle flattened, and separated from sides by an angular keel. Surfaces everywhere hispid Perforations of supratemporal plate numerous. Lower lip very thin, and entirely smooth Plates of belly in two lateral rows which are directed forwards, and are separated by a single row on the middle line, which is sometimes more or less incomplete, thus permitting those of the lateral series to come in contact. Occipital plate angulate posteriorly, and separated from dorsal spine by two transerse plates and a small median posteriorly.

The pectoral spines reach the base of the ventral fins, and the ventrals fall considerably short of the anal Caudal lobes acute, subequal Radii, D I 7, P I. 6, V. I 5; A I. 5. The spines are all strongly hispid, and those of the pectoral fin are more robust than that of the dorsal Plates of lateral line, 25

Light yellowish brown, with a row of about six oblong dusky spots along the lateral line, which become obscure anteriorly. A series of corresponding spots along the dorsal region. Dorsal and caudal fins light colored with numerous dusky spots. A black spot at the base of the caudal fin in some specimens.

Total length, 56 mm. ; length to base of caudal fin, 48 mm. , length to base of anal, 27 mm. , length to base of ventral, 19 mm. , length to base of pectoral, 10 mm. ; length of head, 10 mm , interorbital width, 7.5 mm

This species need only be compared with the *O affinis* of Steindachner, which is found near to Rio de Janeiro That species has a posterior tuberosity of the occipital plate which is wanting in this species, and Steindachner represents only one entire plate between the occipital and the base of the dorsal spine. This region is more depressed in the *O. flexilis*, and the body is considerably more compressed, from the dorsal to the caudal fins The eye is also smaller than in the *O affinis* The lip is even weaker than in the *Hisonotus leptochilus*

Rio Jacuhy Rio Grande do Sul numerous specimens

OTOCINCLUS FIMBRIATUS sp nov

Form moderately stout depth at base of D I entering length without caudal fin four times Head rather depressed with the muzzle rounded entering the length (measured to opercular border) three and a half times Eye entering length of head 4 25 times and the flat interorbital space 2 75 times Posterior lip well developed coarsely tubercular its border together with the border of the anterior lip and the inner edge of the beard fringed with obtuse processes Occipital plate with acute apex separated from base of dorsal spine by two transverse plates and a small median posterior one Venter with three series of scuta a lateral series of long ones directed forwards on each side and a row of median scuta in contact with them Scales everywhere hispid Supratemporal perforations small numerous but concealed by the integument Inferior and superior aspects of caudal region flattened and separated by an angular keel from the sides

Origin of dorsal fin immediately above that of the ventral Caudal lobes acute equal Radii D I 7 P I 6 V I 5 A I 5 Pectorals reaching a little beyond base of ventrals latter barely reaching base of anal Twenty five rows of scuta in lateral line

Color light reddish yellow There are four large dusky spots along the lateral line the anterior enlarged and obscure A series of corresponding dorsal spots Caudal fin with three vertical dusky bars which are sometimes broken into spots Other fins with a dusky spot at base the anal and dorsal with the spinous ray entirely dusky Below straw color

Total length 38 5 mm length to base of caudal fin 28 mm length to base of anal 18 5 mm length to base of ventral 13 mm length to base of pectoral 7 5 mm interorbital width 5 5 mm

This is the smallest of the Siluridæ here described and is to be compared with the *Otocinclus affinis* already mentioned The angulation and elevation of the nuchal region described by Steindachner as characteristic of that species are here wanting and the fringe of the lips is not figured nor described by him The eye is considerably smaller entering the length of the head to the apex of the occipital shield 5 5 times instead of four times In the *O affinis* there is a longitudinal lateral band instead of spots and the fins are not represented as spotted as is the case with the *O fimbriatus* As compared with the *O flexilis* the *O fimbriatus* differs greatly in the tubercular and fringed lip relating to it in this respect much as the *Hisonotus laevior* does to the *H leptochilus* It is a smaller species than the *O flexilis* and is more brightly colored and with less numerous lateral spots The ventral fins are relatively longer, and the dorsal fin originates above their base and not behind it as is the case in *O flexilis*

Rio Jacuhy Rio Grande do Sul numerous specimens

In the many specimens of this species and the *O flexilis* in the collection the adipose fin spine is constantly wanting

PLECOSTOMUS COMMERSONII Val

One adult specimen A young individual which I suppose to belong to this species exhibits the following characters

Scuta not connected with each other anterior to the posterior border of the dorsal fin and consisting of a median ossification only each scute supporting a median comb of bristle like teeth which is longitudinal on most of them and is directed obliquely upwards posteriorly on the superolateral series Besides the central comb each scute has a shorter one near its superior and inferior extremities Inferior surface as far as the vent without granules or scales Scuta of lateral line, 28 Traces of a longitudinal angle on the posterior part of the supratemporal plate and of two near together on the posterior part of the occipital Head marked with coarse granular ridges which are little marked on the suborbital and interorbital regions and are replaced by fine lines on the anterior part of the occipital plate Muzzle acuminate oval viewed from above tip naked sides without bristles Occipital bounded posteriorly by a single nuchal plate which is separated from the basal dorsal fin plate by a second nuchal Lip large entire coarsely tubercular Teeth about ½ on each side The humeral angle extends on two plates only

Fin radii D I 7 P I 6 V I 5 A 5 The eye enters the length of the head to the apex of the occipital plate six times three times in the muzzle, and 2 25 times in the interorbital space which is plane The base of the dorsal fin is as long as the space from its posterior ray to half way between the adipose fin and the base of the caudal The pectoral extends a little beyond the base of the ventral and the ventral to a short distance beyond the posterior ray of the anal fin The inferior apex of the caudal fin is considerably longer than the superior

Total length 47 mm length to base of caudal fin 34 mm length to base of anal fin, 23 mm length to ventral 17 mm length to base of pectoral, 9 mm, length of head to apex of occipital plate 18 mm Color in alcohol reddish brown an obscure dark shade about the base of the dorsal fin A single row of dusky spots in each membranous space of the dorsal fin Caudal fin with about three oblique vertical cross rows of rufous spots

The single specimen on which this description is founded is probably young, yet various indications point to its being of small size at maturity The well-developed lip and tubercles are those of a mature fish and the relatively small size of the eye indicate that little change is to be looked for in the proportions of the head It is probable that the deficient ossification of the anterior body plates is a character of immaturity

PLECOSTOMUS ASPILOGASTER sp nov

Head with three obtuse angles the lateral extending posterior to the orbits the median obscure between the orbits but distinct on the occipital plate Belly covered with granular scales which are collected into indistinct scuta posterior to the lip Posthumeral ridge short covering only four or five scuta Besides this the scuta are not keeled but are distinctly angular on the dorsolateral and ventrolateral rows and traces of keels exist on the anterior scuta of the two median lateral rows Occipital plate bounded posteriorly by two scuta which are obtusely angulated and these are separated from the base of the dorsal spine by three transverse nuchal plates each of which has an obtuse lateral angle of the surface There is a naked patch on the end of the muzzle which does not reach the superior surface Eye small entering length of head eight times muzzle five times and interorbital space 3 75 times Lateral line of scuta 30 All the scuta are rough with longitudinal ridges but they are not very spinous Inferior and superior surfaces of caudal peduncle flattened Length of head entering total (without caudal fin) three and one third times

Base of dorsal fin equal space between its posterior ray and a point half way between adipose and caudal fins First dorsal ray equal length of head shortest caudal rays equal from end of muzzle to posterior border of orbit Radii D I 8 in three specimens I 9 in one P I 6 V I 5 A 5 Pectoral extending to basal third of ventral ventral to posterior border of anal Teeth [illegible] on each side the terminal portion elongate amber colored Length of median caudal rays 66 of length of head

Total length 230 mm length to base of caudal fin 198 mm to base of anal 122 mm to base of ventral 82 mm to base of pectoral 41 mm Length of head to posterior border of occipital plate 54 mm width of head at opercular fissure of lateral angle 49 mm Length of specimen with dorsal radii I 9 275 mm

Color above dark brown spotted anteriorly with dusky below unspotted light brown There are two or three dusky spots on each scuta but these are not visible posterior to the dorsal fin The head is closely spotted with very small dusky spots which are large and more distinct on the supratemporal region where they have a diameter of about a millimeter and are separated by spaces of about the same diameters The dorsal fin is coarsely spotted with dusky, there being one or two rows on each interspinous membrane The pectorals, ventrals and anal are similarly spotted with a single row between the spines and the caudal fin is unspotted

In general proportions, and in the fin and scale formula this species resembles the *P commersonii*, but in various other respects it apparently resembles the *P carinatus* of Steindachner It differs from this species in the very obscure or absent carination, in the much smaller eye, and in the shorter base of the dorsal fin, according to its describer It is from the Jutahy in Western Amazonia The four specimens of the *P aspilogaster* before me are from the Jacuhy Rio Grande do Sul This species also approximates the *P limosus* Eigenm (*Proceeds Calif Acad Sci* 1888 pp 167–8) from the Uruguay R According to the description this species has the occipital plate bordered by a single nuchal instead of by three, and the middle rays of the caudal fin are nearly equal to the length of the head The postdorsal region should be rounded above and below whereas it is flattened, and the fins and belly are spotted In the *P aspilogaster* the caudal fin and belly are without markings

The *Plecostomus virescens* Cope (*Proceeds Academy Philadelphia* 1874 p 187) was founded on young individuals from Eastern Peru The Eigenmanns state their inability to locate it in their system of Nematognathi In their table of the genus Plecostomus (*l c* p 398) is a section which includes species with the ventral integument more or less scaleless a character which Boulenger alleges to be more or less untrustworthy In any case two specimens of the *P virescens* of 60 mm in length have the belly smooth In one of 70 mm a few granules appear on the median line of the belly In one of 93 mm a band of granules extends from the anus to the coracoid bridge on the middle line spreading and fading out laterally on the belly Supposing the latter character to be retained to maturity (which is uncertain) the *P virescens* differs from the species referred to the section with naked bellies by the Eigenmanns Disregarding the squamation of the belly the former enters the section which includes the *P bicirrhosus* The l l is 26–7 Superciliary borders a little raised The triangular part of the occipital bone is bordered by two scuta on each side, and one scutum which touches the apex and none of them are angulated Body scales not keeled The base of the dorsal equals its length from the adipose fin A few small spines at the inferior opercular angle Head and body unspotted All the fins spotted Apparently nearest the *P villarsi* Luetken

CALLICHTHYS TAMOATA Linn

CORYDORAS PALEATUS Jenyns *C marmoratus* Steind *Denkschr K Akad Wien*, 1879 (see Pl v, Fig 1) good figure

About sixty specimens, varying in length from 35 mm to 70 mm I have examined about fifty of these in order to ascertain whether there is any variation in the degree of extension of the coracoid bones over the pectoral region There is no variation that of each side remaining widely separated from the corresponding one of the other side in all the specimens Not having met with any variation in any of the species in this respect, I distinguished the species where the pectoral region is enclosed below by the coracoids, as a distinct genus retaining for it the name Corydoras and naming the series with naked breast, Gastrodermus * According to Eigenmann,† the type of Corydoras, *C punctatus* L , possesses the character which I have assigned to Gastrodermus which is therefore the true Corydoras It therefore becomes necessary to give the genus with armored thorax a new generic name This I propose shall be Osteogaster The type is the *Corydoras eques* of Steindachner and the only other species which can be positively assigned to it is according to Eigenmann, the *C splendens* Castelnau

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* *Proceeds Amer Philos Soc* 1878 p 681

† *Revision of S Amer Nematognathi* 1890 p 405

ICHTHYOCEPHALI

Prof Gill has called my attention to an error which occurs in my paper on the classification of fishes published in 1871 in the exchanged places of the genera Monopterus and Symbranchus The characters of the one are by an inadvertence ascribed to the other by an accidental exchange of the names

SYMBRANCHIDÆ

SYMBRANCHUS MARMORATUS Bloch

HAPLOMI

CYPRINODONTIDÆ

GIRARDINUS CAUDIMACULATUS Hensel, *Arch f Naturgesch* 1870 p 362
Von Jhring *Susswasserf v Rio Grande do Sul* 1893 p 28

Depth of body a little greater than length of head Dorsal fin originating above middle of anal Scales 28–8 Radii D I 7 A 10 Eye one third head exceeding length of muzzle and 1 5 times in interorbital width Scales between interorbital space and dorsal fin, 18 Yellowish with a black vertical spot on the thirteenth scale from the caudal fin

PERCOMORPHI

CICHLIDÆ

CRENICICHLA LEPIDOTA Heckel, Steindachner, *Sitzber K Wien Akad Wiss*, 1874 p 22

Numerous specimens, evidently the common perch of the Jacuhy

CRENICICHLA LACUSTRIS Cast Steindachner, *Sitzber K Wien Akad Wiss*, Dec, 1874, p 18

Form elongate, body compressed profile gently decurved from the first dorsal ray to the upper lip which is less produced than the prominent mandible The length of the head is contained in the total 3 66 times, and into that of the head and body three times Depth of body contained in total 5 5 times, and into that of head and body 4 5 times Eye not large, entering length of head 6 5 times, twice in muzzle without chin, and 1 6 times in interorbital space, which is slightly convex transversely Scales $\frac{7-9}{25}$, those of the lateral line fewer than those of the transverse rows, for the reason that on the anterior part of the body one lateral line scale is bounded by three scales of the transverse rows, and on the posterior part of the body one lateral line scale corresponds to two transverse rows. Thus the transverse rows number 72 while there are only 40 in the lateral line. Radii D XX 14; A III 9; V I 5; P 17. Color brownish above and yellowish below in alcohol. Sides of body and head with dorsal and anal fin rather sparsely spotted with small black spots. A much larger black spot at the base of the caudal fin which is not light bordered. A black band from the eye to the opercular border, and another very distinct one from the eye downwards across the cheek. Paired fins uniformly yellowish.

Total length, 196 mm; length to base of caudal fin 169 mm; length to base of anal 115 mm; length to base of ventral 89 mm; length to base of dorsal (axial) 53 mm.

The number of transverse rows of scales is intermediate in the genus while the number of those traversed by the lateral line is smaller than is mentioned by authors as occurring in any known species. The prominence of the lower jaw approximates a character of the *G. lucius* Cope of the upper Amazon but in that species the top of the head is flat and horizontal and not convex and decurved. The scales are also larger.

But three specimens of this fish were taken by Mr. Smith. The smallest measures 137 mm in total length and differs as a younger individual in the larger eye which enters the head 4.75 times and equals the interorbital width. Radii D XXII 13; A III 9. Scales $\frac{3}{41}$; the transverse series twice as numerous as those of the lateral line posteriorly and three times as numerous anteriorly. Besides the black specks there is a row of eight dusky spots on the side of the body.

GEOPHAGUS GYMNOGENYS Hensel, *Arch. für Naturgesch.* 1870, p. 61.
Von Jhring, *Susswasser Fische von Rio Grande do Sul* 1893, p. 31.

I find four species of *Geophagus* in the Smith collection which differ as follows:

a. Cheeks naked or nearly so.

Profile nearly straight; eye one third head; caudal fin emarginate; anal soft rays 8; body oval; smaller. *G. gymnogenys.*

Profile of skull strongly convex at orbit; eye one third head; outline of body contracting from first dorsal spine posteriorly; caudal fin truncate; anal soft rays 8; smaller .. *G. camurus.*

aa. Cheeks scaly.

Profile straight; preorbital bone wider; caudal fin truncate; anal with eight soft rays; eye one fourth head; 1 1, 25; smaller. *G. brachyurus.*

Profile straight; preorbital bone much wider; eye more than four times in head; body oval; 1 1, 28; anal with nine soft rays; caudal fin rounded; larger .. . .*G. brasiliensis.*

In each of the four species of Geophagus here described, the inferior bounding fold of the inferior lip is interrupted at the middle line. The lamelliform lobe of the first branchial arch is simple in the *G gymnogenys* In *G camurus* and *G brachyurus* its border is divided into digitate processes In my specimen of *G brasiliensis* the digitate processes are present but rudimental Hensel has distinguished a species as characterized among other points by the absence of scales on the cheek Steindachner does not appear to have met with this condition in the *G brasiliensis* yet he refers Hensel's species to the latter believing that the absence of scales from the cheek is an abnormality probably most frequent during the spawning season I find the character on the contrary to be constant in the eight specimens of *G gymnogenys* and *G camurus* which are of different sizes and ages and which are characterized by well marked peculiarities of the form of the head and the body The scales are constantly present in five specimens of the *G brachyurus* which are of the same size as those of the *G gymnogenys* and *G camurus* and are associated with equally well marked specific characters I believe with Von Ihring that Hensel is right in regarding the character as of specific value

In the *Geophagus gymnogenys* the anterior border of the orbit is as far from end of muzzle as the posterior border of the orbit is from the convexity of the opercular border Profile nearly straight dorsal fin not scaly at base Cheek naked except a patch of five scales between the orbit and preopercle Preorbital bone a little wider than tegumentary orbit Scales $\overset{3}{\underset{8}{28}}$ Fin radii D XIII 11, A III 8 Body deep the depth contained in the length to base of caudal fin 2 83 times length of head in the same three times Pectoral fin reaching first soft ray of anal caudal fin openly emarginate

Color brown each scale with a paler centre A dark brown spot extends over the dorsum immediately in front of the dorsal fin and extends to the lateral line on each side Two dark spots below the spinous dorsal fin and two below the soft dorsal above the lateral line A dark spot below the lateral line behind the superior opercular angle and another on the side below the rays xi and xii of the spinous dorsal Dorsal and caudal fins dusky with rather numerous oval and round pale spots A dark spot on superior part of operculum and one below eye

Total length 107 mm length to base of caudal fin 87 mm length to base of anal 58 mm length to base of ventral, 39 mm length of head side 26 mm

One specimen

GEOPHAGUS CAMURUS sp nov

Anterior border of orbit more distant from end of muzzle than the posterior border is from convex border of operculum Profile strongly convex at and in front of the orbit Form most elevated at the base of the dorsal fin, then tapering posteriorly Cheeks naked or with one or two obscure scales Preorbital bone a little wider than tegumentary orbit

Scales $\begin{matrix}3\frac{1}{2}\\28\\7\end{matrix}$ Fin radii D XIV 10 A III 8 two out of seven specimens with the dorsal spines XIII and two with the soft rays of the anal 9 Caudal fin truncate Greatest depth entering length minus caudal fin 2 5 times length of head in same three times Diameter of eye entering head three times Pectoral fin reaching first soft ray of anal

Color brown each scale with a paler centre The spotting is similar to that of the *G gymnogenys* except that the dorsal region is dusky and without well defined spots the saddle shaped black spot in front of the dorsal only remaining Below the lateral line on the middle of the side is a strongly defined spot and traces of one behind the epiclavicle are also visible A dark bar below the orbit which is absent from most of the specimens which have been somewhat bleached by alcohol Fins spotted as in *G gymnogenys*

Total length 95 mm length to base of caudal fin 72 mm length to base of anal 48 mm length to base of ventral 26 mm length of head on side 24 mm

Seven specimens This species is near the *G gymnogenys* but differs much in the form of the head and body and in the number of the rays of the dorsal fin

GEOPHAGUS BRACHYURUS sp nov

Anterior border of orbit about as far from the end of the muzzle as from the convexity of the opercular border Preorbital bone distinctly longer than diameter of tegumentary orbit Profile straight slightly concave at orbit Form of body to caudal peduncle an oblong oval Cheeks with five rows of scales below orbit Scales $\begin{matrix}3\frac{1}{2}\\2\\8\end{matrix}$ Fin radii D XIV 9 A III 8 In two specimens the dorsal rays are XV 9 and XIII 10 and in the latter specimen the anal rays are III 9 in a thin specimen the anal rays are III 7 Caudal fin truncate Greatest depth entering the length minus the caudal fin 2 2 times length of head entering the same 2 75 times Diameter of eye entering side of head four times

Color in alcohol brown the dorsal and anal fins blackish The color of the spinous part of the former is varied by the presence of oblique spots of a pale color which form stripes running upwards and backwards These transparent spots are wanting on the anal fin A black spot at base of first dorsal rays , another below the lateral line below the middle of the spinous dorsal and a black bar below the eye

Total length, 97 mm length to base of caudal fin 75 mm length to base of anal, 59 mm , length to base of ventral, 35 mm , length of head 28 mm

Five specimens This species is well distinguished from the species previously described, by the smaller eye, and an abbreviation of the body posteriorly The latter character reduces the number of scales of the lateral line and alters the relative proportions generally Thus the length of the caudal peduncle equals that of the preorbital bone to the orbit in the *G gymnogenys* it equals the length of that bone plus the diameter of the orbit The coloration of the fins is also peculiar

GEOPHAGUS BRASILIENSIS Quoy and Gaimard, Steindachner *Sitzb K Wien Akad* 1871 December p 13

Anterior border of orbit considerably farther from the end of the muzzle than the posterior border is from the convex edge of the operculum The middle of the length of the head falls near the middle of the pupil Profile straight and steeply descending Preorbital bone 1 75 times as long as the diameter of the orbit Cheeks with five rows of scales Form of body oval a little higher in front Scales $\frac{4\frac{1}{2}}{\substack{29\\8}}$ Fin radii D XV 11 A III 9 Greatest depth two and one third times in length to base of caudal fin length of head in same two and three quarter times Diameter of eye entering head 4 66 times and twice in the interorbital width measured over its strong convexity Caudal fin rounded truncate in the middle its basal portion scaly throughout

Color light brown in alcohol each scale with a paler centre a large black spot below the lateral line opposite the middle of the spinous dorsal fin A few scattered pearl blue spots on the operculum and on the scales posterior to it Caudal fin spinous dorsal and base of soft dorsal dusky the caudal with oval transparent spots and the spinous dorsal with a few oblique transparent streaks directed upwards posteriorly A few round transparent spots at the posterior base of the soft dorsal Paired fins unspotted the anterior rays of the ventrals dusky

Total length 193 mm, length to base of caudal fin 158 mm length to base of anal 102 mm length to base of ventrals 58 mm length of head, 54 mm

This species agrees with the *G gymnogenys* and *camurus* in its scale formula and with the *G brachyurus* in its scaly cheek and coloration It differs from all of them in the more posterior position of the eye and length of preorbital bone, and in the shape of the caudal fin In some respects it agrees with the *Geophagus microlepis* of Gunther * but in that fish the eye has a much more posterior position There is but one specimen of the *G brasiliensis* in the collection

ACARA TETRAMERA Heckel *Brasil Fluss Fische, Ann der Wien Mus*, ii, p 341 Steindachner *Sitzber Wien Akad*, 1875 January p 5

Numerous specimens Dr Steindachner having endeavored to show that the *A flavilabris* Cope, is identical with this species I embrace the present opportunity of making a direct comparison With five speci mens of the *A flavilabris* before me I find that there are but two rows of scales on the cheek one row on the inferior limb of the preopercle and one on the interopercle as I have figured and described In *A tetramerus* there are three rows on the cheek and none on the preopercle and interopercle as described by Steindachner The preorbital bone is only 0.5 the diameter of the orbit in *A flavilabris* as in the younger *A tetramerus* The front between the orbits is absolutely flat in *A flavilabris* while it is convex at the borders in *A tetramerus* All the specimens of *A flavilabris* have XVI dorsal spines In all the lower lip is conspicuously yellow a character not present in the *A tetramerus* in my collection nor described by authors The absence of this characteristic mark is the only fault in my figure *

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* *Catal Fishes Brit Mus* iv p 314

ACARA AUTOCHTHON Gthr Steindachner *Sitzber K Wien Akad* 1874 December p 4

SUMMARY

The species enumerated in the preceding pages are distributed in families as follows

	Total	New Genera	New Species
Clupeidæ	1	0	0
Characinidæ	15	3	9
Sternopygidæ	2	0	0
Siluridæ	14	0	6
Symbranchidæ	1	0	0
Cyprinodontidæ	1	0	0
Cichlidæ	8	0	2
Total	42	3	17

Besides the addition of seventeen species to the fauna of the Jacuhy river five genera are introduced Four of these are Characinidæ viz Asiphonichthys Chorimycterus Diapoma and Pseudocorynopoma Of these the first three are new to science and the last has been previously known from the drainage of the La Plata only The fifth genus is Sternopygus which has not been enumerated by previous authors as found in the Jacuhy river

NOTE

Mr Smith obtained near Chapada in Matto Grosso from the head waters of the Paraguay *Tetragonopterus lineatus* Steind and *T moorei* Boul From the head waters of the Tocantins not far from the same locality he obtained a species close to the *T caudimaculatus* Gthr

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* *Proceeds Academy Phila.* 1872 p 255 Pl xi Fig 4

EXPLANATION OF PLATES.

Figures all natural size unless otherwise stated

PLATE IV.

Fig. 1. *Xiphorhamphus brachycephalus* Cope ; *a*. head from above.

PLATE V

Fig. 2. *Anphonichthys stenopterus* Cope
3. *Chorimycterus tenuis* Cope.
4 *Diapoma speculiferum* Cope
5 *Tetragonopterus pliodus* Cope.

PLATE VI.

Fig. 6 *Tetragonopterus jacuhiensis* Cope.
7. *Tetragonopterus laticeps* Cope.
8. *Tetragonopterus eigenmanniorum* Cope.
9. *Chirodon monodon* Cope.

PLATE VII.

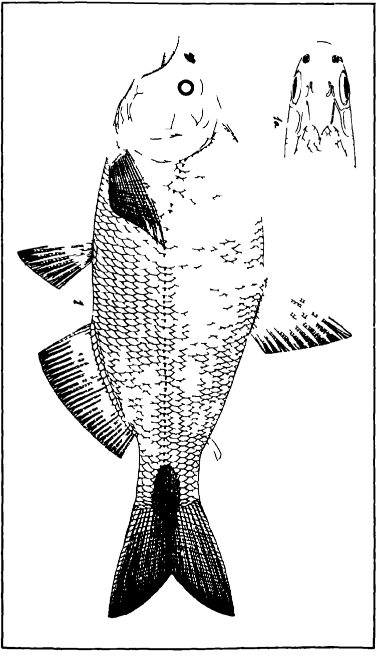
Fig. 10. *Rhamdella straminea* Cope.
11. *Hisonotus leptochilus* Cope. *a* Head from above ½ natural size, *b*. Head from below.
12. *Hisonotus laevior* Cope. *a*. Head from above ½ natural size, *b*. Head from below.
13. *Otocinclus flexilis* Cope. *a* Head from above ½ natural size, *b*. Head from below.

PLATE VIII.

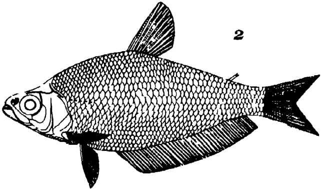
Fig. 14. *Plecostomus aspilogaster* Cope, ¾ natural size. *a*. head from below × ½.
15. *Loricaria cadea* Hensel, from side. *a*. From above ; *b* From below ½ natural size.

PLATE IX.

Fig. 16. *Otocinclus fimbriatus* Cope. *a*. Head from above × 2 ; *b* Head from below × 2.
17. *Geophagus gamurus* Cope.
18. *Geophagus brachyurus* Cope.



Plectospondylis



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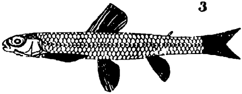

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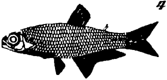

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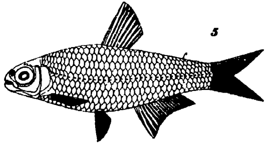

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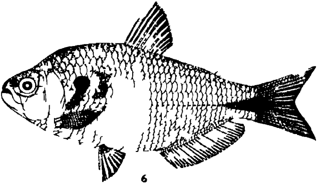
Plectospondyli.



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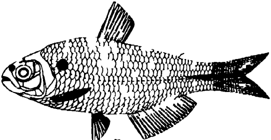

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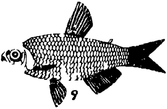

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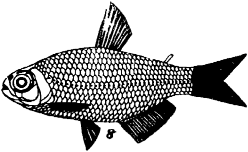

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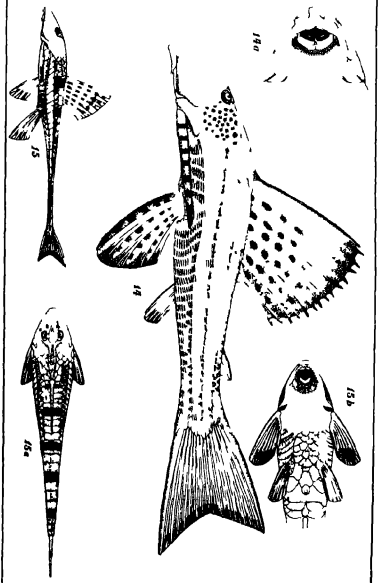
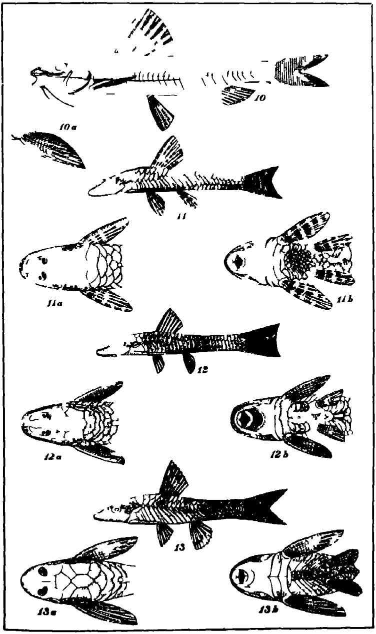
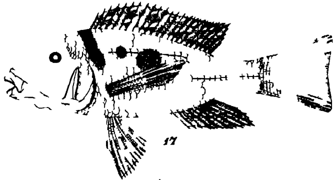
Plectospondyli



Nematognathi



Nematognaths.



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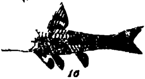

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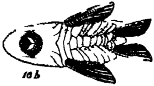
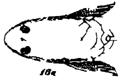


16 b



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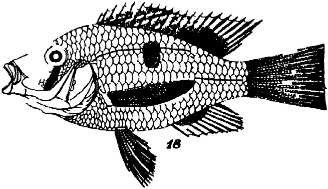

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16 *Nematognathi* 17 18 *Percomorphi*

On the Structure of the Skull in the Plesiosaurian Reptilia, and on Two New Species from the Upper Cretaceous.

By E. D. Cope.

(Read before the American Philosophical Society, February 2, 1894.)

Prof. S. W. Williston has described in the *Proceedings of the Kansas Academy of Science* for 1890, the skull and part of the skeleton of a Plesiosauroid from the Niobrara Cretaceous of Kansas, under the name of *Cimoliasaurus snowii*. Through the kindness of Prof. Williston, I have had the opportunity to examine the specimen, and I have been able to make some observations on the structure of the skull, which supplies an important desideratum in our information on the subject.

In a paper in which I endeavor to trace the homologies of the cranial bars of the Reptilia,[*] I ascribe[†] to the Sauropterygia a single postorbital arch, and state that the available evidence is to the effect that this is the zygomatic. I remark, "The supratemporal has no anterior connections according to this author" (Von Meyer on Nothosaurus), "and the supramastoid is not described. From all that I can gather from Owen's figures and descriptions of Plesiosaurus, the structure is the same, which is confirmed by observation on such imperfect specimens as are accessible to me."

Examination of Williston's specimen shows that there is but one postorbital bar, and that this is partly the zygomatic, since it extends to the distal extremity of the quadrate, and encloses with it a small zygomatic or quadratojugal bone. But the posterior part of the arch includes also a large supratemporal, as in many Testudinata. Above the supratemporal, and forming the parietomastoid arch, is the separate element which I have referred to in the above quotation as supratemporal, but which it is now clear is the supramastoid. It is then homologous with the element in Ichthyosaurus and in the Cotylosauria, which I have called by that name. This discovery enables me to demonstrate the correctness of my supposition made in the paper already quoted (pp. 19–22), that the postero-lateral process of the parietal bone, so characteristic of Sphenodon and Lacertilia, really includes the supramastoid element. There is no question about the distinctness of this element from the parietal in the Cimoliasaurus, and the suture is shown in the outline figures given by Williston in his description referred to. The suture between it and the supratemporal is not so distinct, but is nevertheless visible. The following figure is copied from Williston, with the sutures inserted as I observed them.

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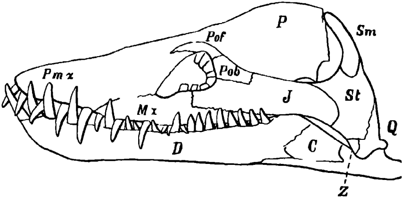
[*] "On the Homologies of the Posterior Cranial Arches in the Reptilia," *Trans. Amer. Philos. Soc.*, 1892, p. 11.

[†] L. c., p. 21.



Posterior part of right side of skull of C [illegible] Willist
Modified after Williston

I embrace the present opportunity to correct an error into which I inadvertently fell when naming the elements of the cranium in the Cotylosauria in the essay above quoted That segment which forms the lateral angle of the superior table of the skull in the Cotylosaurian reptiles the Stegocephalous batrachians and many fishes is there termed the *os intercalare* after Cuvier It is however not his intercalare but his external occipital This is the epiotic of Huxley but as it is not homologous with that element in the Reptilia it requires another name I propose that it be called the *os tabulare* or the tabular bone I do not know of any reptiles other than the Cotylosauria in which it is present (see Pl x *I ib*)

I refer in this connection to a taxonomic question which depends on a correct knowledge of the posterior part of the Reptilian skull Huxley * referred the Triassic genus Telerpeton to the Lacertilia and I afterwards † endeavored to show that this genus together with Rhynchosaurus Hyperodapedon and Saurosternum belong to the Rhynchocephalia In this I have been followed by most authors who have since treated of the subject After a study of the cranial arches I became convinced that these genera could not be Rhynchocephalia, ‡ since they possess but one postorbital bar while the Rhynchocephalia possess two In the papers cited below I placed them in the Theromora in the subdivision Progano sauria and associated with them the Proterosauridæ It has become evident that this is their true position, and that they are not far removed from the Anomodontia, with which they were nearly contemporary in time. It is doubtful whether the family of the Mesosauridæ on which the Proganosaurian order was founded by Baur really belongs to this series while the genus Procolophon Owen probably does. This genus has been regarded as the type of a group the Procolophonina by Seeley and the genus Proterosaurus has been made the type of another group by the same author under the name of Protorosauria. I have shown that the postorbital bar of the Pelycosauria (? Theriodonta) is different from that of the Anomodontia and that the Cotylosauria (Pariasauria) is entirely distinct as an order. The Theromora as an order will then include the suborders Placodonta, Proterosauria and Anomodontia. The problematical genera above named will all fall within the limits of the Proterosauria as I have defined it under the name of Proganosauria.

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* *Quarterly Journ Geolog Society* London 1869 p 49

† *Proceeds Amer Assoc Adv Sci* 1870 Vol xix p 241

‡ Synopsis of the Families of Vertebrata *American Naturalist* Oct 1889 *Syllabus of Lectures on Vertebrata Univ of Pennsylvania* July 1891 p 83.

EMBAPHIAS CIRCULOSUS gen. et sp. nov.

Char. gen. Cervical vertebræ short, with the parapophysis and diapophysis distinct at the base and articulating freely with the centrum. Articular faces of the centra concave in the cervical and dorsal regions. Suture of neural arch with centrum persistent.

The limbs of this genus are not certainly known. The three vertebræ on which it is established were found associated with a considerable number of the vertebræ of Elasmosaurus and a number of bones of the arches and extremities. The proper location of the latter has not yet been made.

This is a short necked genus and need not be compared especially with Plesiosaurus, Elasmosaurus and Polycotylus. It differs from Uronautes, Orophosaurus and Trinacromerum in the distinctness of the basal parts of the dia- and parapophyses, and from the first two in the strong concavity of the vertebral centra. It approaches nearest in its vertebral characters to Pliosaurus, but here the dorsal vertebræ are amphiplatyan as in Plesiosaurus. I note here that the vertebral characters of Trinacromerum Cragin, as described by him,* agree with those of Orophosaurus.†

Char. specif. Cervical centrum a regular transverse wide oval, without lateral longitudinal angulation. Dia- and parapophysial facets compressed so as to be vertical, and occupying a line from near the level of the inferior face to the base of the neural arch and fused together at their bases. The bases of the dia- and parapophyses (which are lost) were thus vertically compressed, presenting a character different from that of any Plesiosauroid known to me. On other cervicals than the single one preserved this character may not be so pronounced, but it is not likely to have been entirely wanting on any of them. The outlines of the dorsal vertebral centra are circular, and the slightly concave sides are without angulation. The fossa for the neurapophysis is an anteroposterior oval, which does not extend over the entire length of the centrum. Arches lost, except the bases, which adhere within the fossæ. An epiphysis-like band of vertically lined surface, narrows the median longitudinally lined surface of the middle portion of the surface of the centrum especially at the middle line below where it is thickened A large foramen on each side of the middle line below and a large one below the parapophysis in the cervical and below the neurapophysis in the dorsal centra Some smaller ones on the sides of the dorsals Surfaces of the centra smooth Neural canal narrow

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* *American Geologist*, 1888, p. 404; 1891, p. 171.

† *American Naturalist*, 1887, p. 564.

Measurements

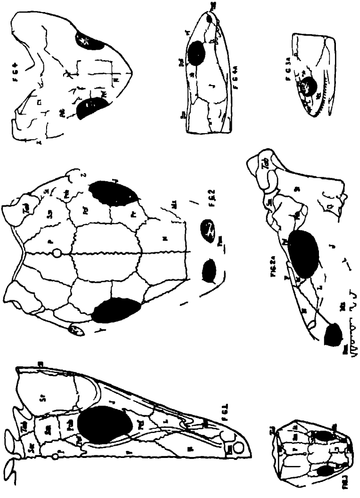
		MM
Diameters of cervical centrum	anteroposterior	45
	transverse	85
	vertical	76
Vertical diameter of common base of dia and parapophysis		67
Diameters of base of parapophysis	anteroposterior	17
	vertical	36
Diameters of a dorsal centrum	anteroposterior	54
	transverse	90
	vertical	95
Width of neural canal at base		19
Depth of concavity of centrum		13

This is a species of large size though not equal in dimensions to the known species of Elasmosaurus It was found in the upper Cretaceous bed of the Pierre epoch at the Big Bend of the Missouri river in South Dakota It was presented to the Academy of Natural Sciences by Mr John H Charles of Sioux City together with the remains of Elasmosaurus below mentioned I wish to express my sense of the obligation under which Mr Charles has placed the Academy and myself by his liberality in this and other matters

ELASMOSAURUS INTERMEDIUS sp nov

Established on a series of nineteen vertebræ of the cervical and anterior dorsal regions of an individual from the Pierre formation of South Dakota

The vertebral centra are the shortest known in the genus approaching the Cimoliasaurus in proportions The median and anterior cervicals display the compressed form characteristic of Elasmosaurus although they are shorter than in the three known species of that genus The posterior median cervical vertebræ are depressed but the centra of the posterior members of that series are less depressed and they increase in length less rapidly than they do in depth They are shorter absolutely and relatively than in the *E orientalis* Cope, to which this species is most nearly related In the anterior dorsals the depth exceeds the length of the centrum while in the *E orientalis* the depth is about two thirds the length The cervicals exhibit an angle of the lateral surface about half way between the diapophysis and neurapophysis The angle disappears on the anterior dorsals The superior and inferior outlines of the articular faces are not emarginate or concave medially, which they are in the *E orientalis*



Stegocephali and Cotylosauria

The lateral walls of the centra near to the articular faces are marked with strong rather sharp ridges which are separated by grooves of several times their width

Measurements

		MM
Diameters of an anterior cervical	anteroposterior	55
	transverse	44
	vertical	45
Diameters of a median cervical	anteroposterior	76
	transverse	70
	vertical	65
Diameters of a posterior cervical	anteroposterior	78
	transverse	107
	vertical	88
Diameters of an anterior dorsal	anteroposterior	74
	transverse	96
	vertical	90

The specimen was found with that of the *Embaphias circulosus* at the Big Bend of the Missouri in South Dakota and was presented to the museum of the Academy of Natural Sciences by Mr John H Charles of Sioux City Ia

ELASMOSAURUS sp

Prof N H Winchell sent me for examination a portion of the vertebral column of a Plesiosauroid from the Niobrara Cretaceous of Dakota (exact locality not known) which consists of forty three centra and portions of the arches and limbs It is one of the shorter necked forms of the genus resembling the *E intermedius* in the proportions of its cervical vertebræ The dorsals are relatively larger but they are all with most of the cervicals so distorted by pressure that it is impossible to characterize the species

EXPLANATION OF PLATE

Permian and Triassic Cotylosauria and Stegocephali

Fig 1 *Mastodonsaurus giganteus* Jaeger $\frac{1}{15}$ nat size from the Trias of Germany From Fraas

Fig 2 *Chilonyx rapidens* Cope , $\frac{1}{15}$ nat size , from the Permian of Texas

Fig 3 *Pariotichus megalops* Cope , nearly nat size from the Permian of Texas

Fig 4 *Pantylus cordatus* Cope , nearly half nat size from the Permian of Texas

Lettering

Tab , Os tabulare , *Soc* , Supraoccipital , *Sm* Supramastoid *St* Supratemporal *Z* , Zygomatic (quadratojugal) , *Pob* , Postorbital , *Pof* Postfrontal , *P* , Parietal , *F* , Frontal , *Prf* , Prefrontal , *J* , Jugal *Q* , Quadrate , *L* , Lachrymal , *Mx* , Maxillary , N , Nasal , *Pmx* , Premaxillary

Forests of Pennsylvania

By J T Rothrock Botanist Member of the Pennsylvania Forestry Commission

(Read before the American Philosophical Society, March 2 1894)

Exact statistics as to the forest area are as yet not available for the State of Pennsylvania It is true that we can speak with some certainty of the area of our State which is devoted to farming interests Deducting this from the known area of the State would however still leave us very wide of an exact statement as to the area actually covered by a growth of wood which is now or ever will be productive forest land There would remain unaccounted for the space covered by cities towns and villages by mines where the surface is allowed to remain unutilized because the wealth below dwarfs its importance and because the surroundings are not favorable to production of trees and lastly there would remain the fact that an enormous percentage of the reputed woodland is now producing timber of the slowest growing and least valuable kinds of wood if indeed it should be designated as wood at all It will be however an approximate statement based upon the reports of our assessors for the year 1892 to say that we have accounted for 16 359 887 acres of cleared land and 9 150 836 acres of woodland This will at least fairly represent farming land and the area covered by woody growth of some kind and may afford a basis for computation as to the condition of things which *should* exist By the above statistics we may account for about 25 535 500 acres of farm and woodland This however leaves from four to six millions of acres of our State area to be accounted for as coming neither under farming nor forest conditions at present Nominally we have nearly 36 per cent of our area in trees, if we accept our assessors statements as a basis of calculation

For convenience sake this paper will be divided thus

I The Kinds of Timber producing Trees in Pennsylvania
II Most Important Timber producing Areas in Pennsylvania
III Configuration of the State in Relation to Growth of Timber
IV Rates of Growth of Most Important Kinds of Timber
V Obstacles to the Growth of Timber
  (*a*) Natural Obstacles
  (*b*) Obstacles due to Human Agencies
VI Relation of the Commonwealth to Forest Restoration
VII Methods of Forest Restoration

I THE KINDS OF TIMBER PRODUCING TREES IN PENNSYLVANIA

The list of such trees indigenous to our State, which are of sufficient size, or in sufficient abundance to be of commercial importance, numbers seventy eight species and is as follows

8 Magnolia glauca L	Sweet bay or swamp laurel
2 Magnolia acuminata L	Cucumber tree
3 Magnolia tripetala L	Umbrella tree
1 Liriodendron tulipifera L	Tulip poplar
2 Tilia Americana L	Basswood
2 Tilia heterophylla Vent	White basswood
8 Ilex opaca Ait	American holly
3 Ilex monticola Gray	Mountain holly
3 Æsculus octandra Marshall	Sweet buckeye
3 Æsculus glabra Willd	Ohio buckeye
3 Acer Pennsylvanica L	Striped maple
1 Acer saccharinum Wang	Sugar maple
2 Acer dasycarpum Ehrh	White or silver maple
2 Acer rubrum L	Red or swamp maple
3 Negundo aceroides Mœnch	Box elder
3 Rhus typhina L	Staghorn sumach
1 Robinia pseudacacia L	Locust
3 Gymnocladus Canadensis Lam	Kentucky coffee tree
3 Gleditschia triacanthos L	Honey locust
3 Prunus Americana Marshall	Wild yellow or red plum
3 Prunus Alleghaniensis Porter	Allegheny plum
9 Prunus serotina Ehrh	Wild black cherry
8 Pyrus coronaria L	Crab apple
3 Pyrus Americana DC	American mountain ash
8 Cratægus coccinea L	Scarlet haw or whitethorn
8 Cratægus punctata Jacq	Blackthorn or pear haw
8 Cratægus Crus galli	Cockspur or Newcastle thorn
3 Liquidambar Styraciflua L	Sweet gum tree or bilsted
9 Cornus florida L	Dogwood or flowering dogwood
8 Cornus alternifolia L f	Alternate leaved dogwood
2 Nyssa sylvatica Marshall	Sour gum, tupelo pepperidge
8 Oxydendrum arboreum DC	Sorrel tree sour wood
2 Diospyros Virginiana L	Persimmon
1 Fraxinus Americana L	White ash
2 Fraxinus pubescens Lam	Red ash
2 Fraxinus viridis Michx f	Green ash
2 Fraxinus sambucifolia Lam	Black hoop ground, or water ash
3 Chionanthus Virginica L	Fringe tree
3 Catalpa bignonioides Walt	Catalpa Indian bean cigar tree

This tree is not a native of Pennsylvania but is becoming rapidly and generally naturalized and is likely to be of considerable importance For this reason I have included it in my list

2 Sassafras officinale Nees	Sassafras
9 Ulmus fulva Michx	Slippery elm red elm
1 Ulmus Americana L	White elm, American elm

2 Celtis occidentalis L	Hackberry nettle tree
2 Morus rubra L	Red mulberry
2 Platanus occidentalis L	Buttonwood sycamore
2 Juglans cinerea L	Butternut white walnut
1 Juglans nigra L	Black walnut
1 Carya alba Nutt	Shellbark or shagbark hickory
2 Carya sulcata Nutt	Big shellbark king nut
1 Carya tomentosa Nutt	White heart hickory mocker nut
1 Carya porcina Nutt	Pig nut or broom hickory
2 Carya amara Nutt	Swamp hickory or bitternut
2 Betula lenta L	Cherry sweet or black birch
2 Betula lutea Michx f	Yellow or gray birch
2 Betula populifolia Ait	White birch
2 Betula papyrifera Marshall	Paper or canoe birch
2 Betula nigra L	Red or river birch
3 Ostrya Virginica Willd	Hop hornbeam leverwood
3 Carpinus Caroliniana Walter	Hornbeam blue or water beach
1 Quercus alba L	White oak
2 Quercus stellata Wang	Post or iron oak
2 Quercus macrocarpa Michx	Bur oak overcup oak
2 Quercus bicolor Willd	Swamp white oak
1 Quercus Prinus L	Chestnut oak rock chestnut oak
1 Quercus Muhlenbergii Engelm	Yellow oak chestnut oak
1 Quercus rubra L	Red oak
1 Quercus coccinea Wang	Scarlet oak
1 Quercus coccinea var tinctoria Gray	Black or yellow barked oak
2 Quercus palustris Du Roi	Swamp or pin oak
3 Quercus falcata Michx	Spanish oak
3 Quercus nigra L	Black jack or barren oak
3 Quercus imbricaria Michx	Laurel oak shingle oak
3 Quercus Phellos L	Willow oak
1 Castanea sativa Mill var Americana Gray	Chestnut
3 Castanea pumila Mill	Chinquapin
2 Fagus ferruginea Ait	Beech

There appears to be no native willow of sufficient importance to merit a place in this list

1 Pinus Strobus L	White pine
1 Pinus rigida Miller	Pitch pine

Under the pitch pine the Pennsylvania lumberman groups what he recognizes as yellow and jack pine

2 Pinus pungens Michx f	Prickly pine poverty pine, table mountain pine
2 Pinus inops Ait	Jersey, or scrub pine

3 Pinus mitis, Michx.	Short-leaved yellow pine, yellow pine.
2 Pinus resinosa, Ait.	Norway pine, red pine.
2 Picea nigra, Link.	Black spruce.
1 Tsuga Canadensis, Carr.	Hemlock.
2 Abies balsamea, Miller.	Balsam, balsam fir.
2 Larix Americana, Michx.	Hackmatack, larch, tamarack.
2 Thuya occidentalis, L.	Arbor vitæ.

The above trees I have divided into a first, second and third class and designated the class by a corresponding figure to the left of the name. Commercial importance and abundance are made the basis of this artificial classification, the only merit of which is that it will serve to impress certain leading facts.

The nomenclature adopted is that of Gray's *Manual of Botany*, which will remain the popular authority until superseded by a more modern book.

II. MOST IMPORTANT TIMBER-PRODUCING AREAS IN PENNSYLVANIA.

The words "most important" timber-producing areas are, of course, in one sense, relative, because they carry a twofold meaning, i. e., important as to quantity produced and important as to the uses made of each kind of wood. In one sense we might consider hemlock and white pine the most important for Pennsylvania, because the former is a characteristic tree of our State and the latter one of immense commercial importance. We shall, however, use the words more especially in regard to the quantities produced on land which may be regarded as by nature better adapted to the growth of timber trees than to any other purpose.

This would naturally suggest the mountain areas of the Commonwealth. It must be remembered, however, that an exclusive consideration of these regions would practically exclude the soil on which our best white oak, black walnut, ash, tulip poplar and linden have grown. Furthermore, land now of more value for agricultural purposes than for any other uses might by some change in price of crops, or by other commercial perturbations, be ultimately found of greater value in production of some quick growing kind of timber. This chance is quite within the limits of possibility in the case, for example, of the chestnut tree, if the fruit should ever become, as in Southern Europe, an important article of food and a stimulus be given to the production of choice varieties of the tree. Indeed, it is by no means certain that we shall not very soon have an example in the increased demand for young chestnut as a source of supply for tannin.

Extending northeast from the southern border of the State through the central third is a region of varied topographical characters. Much of it is mountainous and rocky, and but for the possible discovery of mineral resources and those already known, is of no value except for the growth of timber. The actual area of the land of this character is not yet accurately determined, though it will probably aggregate not less than 5000 square miles Once the timber is removed from such land, under present conditions it becomes not only an unproductive area to the State, but too frequently a nursery of floods during the time of melting snows and in periods of unusual rainfall The Commonwealth has, therefore, a double inducement to restore it to its normal condition, either by direct care, or by such wise legislation as will enable the owners to do so

What this legislation will, or, should be, depends very largely on the condition of the owners of this timber producing area For example, in the State of New York the mountain areas—Adirondacks and Catskills—are comparatively isolated State possession there seems not only the probable, but the natural thing, when one considers that these same mountain regions are most important as water sheds for the eastern parts of that Commonwealth.

On the contrary, in this State the mountain areas are quite too large to encourage the idea that they ever will, or ever should, become the property of the State In short, they will most likely remain in the hands of the small land holder, and the legislation intended for such areas must, from the nature of the case, be chiefly adapted to his needs

Considering the counties of the State alphabetically, it appears that the cleared and the forest acreage of the Commonwealth is as follows:

Table Showing what Percentage of the Entire Acreage of Each County is Timber Land

Counties	Cleared Land	Timber Land	Entire Acreage	Per cent	Classification			
					% 25	% 50	% 75	100
1 Adams	251,637	55,571	307,208	18	18			
2 Allegheny . . .	22,422							
3 Armstrong .	296,111	87,713	383,824	22.8	22.8			
4 Beaver . . .	196,616	59,214	255,830	23.1	23.1			
5 Bedford	340,059	234,277	564,536	41.5		41.5		
6 Berks.	430,516	82,790	513,306	16	16			
7 Blair	141,997	154,292	296,289	52			52	
8 Bradford . .	468,350	204,131	672,481	30.3		30.3		
9 Bucks	350,364	19,151	369,515	5.2	5.2			
10 Butler	365,674	103,526	469,200	22	22			
11 Cambria	322,394	73,507	395,901	18.5	18.5			
12 Cameron .	34,072	189,381	223,453	84.7				84.7
13 Carbon	82,640	109,744	102,890	57			57	
14 Centre	189,580	124,107	313,687	39.5		39.5		
15 Chester	389,306	52,474	441,780	11.2	11.2			
16 Clarion	284,471	75,378	359,849	20.9	20.9			
17 Clearfield . . .	177,227	477,978	655,205	72.9			72.9	
18 Clinton	148,957	405,881	554,838	73.1			73.1	
19 Columbia	186,808	100,426	287,234	34.9		34.9		
20 Crawford	425,103	180,600	605,703	29.8		29.8		
21 Cumberland . . .	231,161	40,057	271,918	14.7	14.7			
22 Dauphin	213,768	102,972	316,740	32.5		32.5		

COUNTIES	CLEARED LAND	TIMBER LAND	ENTIRE ACREAGE	PER CENT	CLASSIFICATION			
					25	50	75	100
23 Delaware	110 000	11 500	121 500	9 4	9 4			
24 Elk	107 611	395 430	503 041	78 6				78 6
25 Erie	403 723	47 164	450 887	10 4	10 4			
26 Fayette	302 274	157 565	459 839	34 2		34 2		
27 Forest	139 701	138 093	77 834	13 8		41 8		
28 Franklin	291 014	134 250	425 294	31 5		31 5		
29 Fulton	114 172	182 636	296 808	61 4			61 4	
30 Greene	341 107							
31 Huntingdon	259 116	229 390	488 506	46 9		46 9		
32 Indiana	342 455	138 916	481 371	28 8		28 8		
33 Jefferson	200 563	187 985	388 550	48 3		48 3		
34 Juniata	139 182	77 122	216 304	35 6		35 6		
35 Lackawanna	237 628	31 790	269 418	11 8	11 8			
36 Lancaster	512 169	57 148	569 317	10	10			
37 Lawrence	186 793	19 221	206 014	9 3	9 3			
38 Lebanon	173 792	38 841	212 633	18 3	18 3			
39 Lehigh	185 620	16 492	202 112	8 1	8 1			
40 Luzerne	800 000	182 400	982 400	56			56	
41 Lycoming	400 000	300 000	700 000	43 3		43 3		
42 McKean	387 088	230 971	618 059	37 4		37 4		
43 Mercer	361 666	39 670	401 336	9 8	9 8			
44 Mifflin	138 155	135 325	273 480	45 8		45 8		
45 Monroe	152 100	170 810	322 910	52 8			52 8	
46 Montgomery	269 582	12 044	281 626	4 3	4 3			
47 Montour	59 811	15 314	75 125	20 4	20 4			
48 Northampton	189 591	21 448	211 039	10 2	10 2			
49 Northumberland	184 558	82 221	266,779	30 6		30 6		
50 Perry	150 817	149 658	300 475	49 8		49 8		
51 Philadelphia	80 000	3 000	83 000	3 6	3 6			
52 Pike	25 053	318 472	343 525	92 7				92 7
53 Potter	125 931	552 019	678 890	81 4				81 4
54 Schuylkill	400 000	137 600	537,600	25 6		25 6		
55 Snyder	132 303	66 322	198 625	33 4		33 4		
56 Somerset	291 081	278 223	569 304	48 8		48 8		
57 Sullivan	121 472	147 881	269 353	54 9			54 9	
58 Susquehanna	316 801	159 231	476 032	33 4		33 4		
59 Tioga	372 345	259 356	631 701	41		41		
60 Union	101 437	79 062	180 499	43 8		43 8		
61 Venango	188 658	166 096	354 754	46 8		46 8		
62 Warren	250 314	174 671	424 985	41 1		41 1		
63 Washington	422 637	64 119	486 756	13 1	13 1			
64 Wayne	399 905	26 720	426 625	6 2	6 2			
65 Westmoreland	420 832	148 680	569 512	26 1		26 1		
66 Wyoming	100 337	122 642	222 979	55			55	
67 York	430 213	112 338	542 551	20 7	20 7			

Resume

2	counties not fully reported		
25	have less than	25 per cent	of timber land
27	" more	25	less than 50
9		50	75
4		75	

Cleared land	16 359 387 acres
Timber	9 150 826
Total	25 519 213

25 519) 9 150 826 (35 9 % nearly

or 9 25 nearly

Thirty five 9 10 % of the land reported in timber

From the above it will be seen that there are fifty two counties whose area of timber land is less than fifty per cent of that of the county There are of these seventeen whose area is less than twenty per cent of the entire area of the county

On the other hand there are four counties where the area remaining in timber is at least seventy five per cent of the entire acreage of the county

The assessors reports do not represent the entire acreage of the counties as a rule They are also faulty or rather misleading because much of what is there classified as timber land is not such in any present productive sense Union and Mifflin counties are good illustrations This remark is not designed to cast any discredit on their work There are good reasons why they could make no nearer approach to an exact statement and the wonder is that they have done so well From four of the counties no exact report has been had It is quite clear that of this thirty five per cent not less than one fourth is producing nothing that should be called timber

III CONFIGURATION OF THE STATE IN RELATION TO THE GROWTH OF TIMBER

In the present condition of affairs in this Commonwealth it is safe to assume that land which is too poor to yield remunerative crops had better be devoted to the growth of something else than the growth of cereals or to put the proposition more broadly agriculture on such ground does not pay To this one may add another proposition which comes partly as a sequence of the first i e that land so steep as to be farmed at a disadvantage unless it is specially adapted to grazing tending to become impoverished by the washing away of the elements of fertility and requiring constant restorative measures is not remunerative under ordinary agriculture and therefore should be restored to growth of timber It is to be observed that these statements are made not as a basis for any State interference but merely as suggestions for the individual land owner

The most important timber trees of this State are white pine, hemlock, white oak rock oak pitch pine shellbark and pignut hickory black walnut locust and chestnut Of these the white pine is a tree of wide geographical range and of equally wide powers of adaptation to conditions of soil and climate Originally it grew more or less commonly, through the State from the northern to the southern boundary and most abundantly along the central meridian It is especially noteworthy that though its favorite locality was on the higher poorer soils where when once cleared the land had little agricultural value that it still grew luxuriantly on some of the lower richer lands What the original rate of reproduction over most of its area was cannot now be answered with certainty It is however safe to say that on the soil best adapted to its growth in the central part of Pennsylvania one may expect to see a tree of this species grow in from fifty five to sixty five years to a diameter at two feet above the ground of from eighteen to twenty two inches Such timber is not mature An inspection of the stump of one felled at this age will reveal the fact that the tree was then in the most productive period of its growth and hence that it was poor policy to sacrifice it then

The hemlock prefers the rocky sides of our mountain gorges or a rocky hillside overlooking a stream Occasionally it appears in a deep forest on a flat by a stream It is very scarce along the southern border of the State except in the mountains proper where it extends its range to the south

If it were required to select a single tree which should be peculiarly representative of Pennsylvania the hemlock would probably most fully be so Here to a greater extent than in any other State it has been an important tree in our lumbering interests and no less important in the manufacture of leather Here also its most reckless destruction has been witnessed where miles of matured hemlock forest have been absolutely sacrificed for the bark alone In this State also there are probably more miles suited to reproduction of hemlock than in any other Northern State In some respects the hemlock is peculiar for example the nurseryman finds no great trouble in raising it, growing it into hedges or even into isolated trees Yet the experience of our lumbermen and the few who have tried to restore it as a forest tree has not been encouraging Of course there are reasons for the different results mainly due to the fact that the forester works under conditions which are inimical to its growth and which to a large extent, the nurseryman can avoid Still the fact remains that the hemlock is among the slowest of our forest trees in its early growth and when the shade under which it originally grew is destroyed the difficulties of its reproduction are immensely increased It is, however, of the utmost importance to the Commonwealth that its restoration be attempted first, because of its intrinsic value , second, because it grows and thrives on land which, but for it, would be almost valueless The hemlock is, as a rule, a tree having but little tap root Its roots spread out along or just beneath the surface of the soil Yet as one of the biological marvels connected with this wonderful tree, it will often be found attaining its most vigorous growth and size on a rocky hillside where there is almost no soil in sight Of course it is clear that under such conditions it must have departed from its usual rule and sent its roots deeply down beneath the surface

The white oak would probably come next in popular esteem It is however fairly a question whether the rock oak is not of greater commercial importance to this State The best white oak as regards both strength and durability contrary to the general opinion comes from the rich alluvial lands To the truth of this proposition both science and the most intelligent experience testify Probably of all our important forest trees no species is more readily grown than the white oak Mere altitude (so far at least as our State is concerned) appears to be no obstacle to its growth We find it at the level of tide and also at an elevation of two thousand feet and upwards It will flourish along the mountain sides then suddenly disappear as you reach the steeper rocky slopes where the rock oak by its abundance gives character to the forest It can hardly be supposed that altitude alone has been the determining cause of its disappearance The statement has already been made that white oak from higher poorer soil was of inferior quality and this may indicate such a lack of physical vigor as makes it unable to cope with the hardier rock oak and locust which abound on such situations Some of the most thrifty young white oak groves I have found in this State have been between the altitudes of one thousand and seventeen hundred feet above the sea level In such situations the soil however was loamy and with so few rocks that once cleared it might well enough have served for agricultural purposes On the mountain slopes just at the foot of the steeper incline where there is an accumulation of loam washed from the heights above the growth of white oak is often the most vigorous This fact seems to obtain in our State without regard to altitude and points again to the conclusion that for the most successful growth of this species, a fertile comminuted soil is of the first importance

Rock oak, locust and chestnut form in one sense a group by themselves—that is they agree markedly in certain peculiarities of habit, being always found associated under certain conditions, and yet on the other hand each able to thrive under conditions which would be inimical to the best development of the other For example they all may be expected to grow in association along those mountain slopes where the Medina and Oneida sandstones appear neither altitude nor the rocky masses seem to prevent their growth Yet the limestone almost certainly exercises a limiting influence on the chestnut and possibly on the rock oak, while the locust often becomes a very large tree on limestone soil

The pitch pine may be regarded as a tree of pliant constitution Its most constant home is on the higher mountain areas of the State It is, however, to be observed that the reason why it now appears most frequently there is simply because it has been largely extirpated from all other sites The mountain tops are its remaining strongholds It is however also found growing in the sands of the seashore

The hickories (shellbark and pignut) are trees of lower ground The former seldom leaves the alluvial flats and though the latter is often found on the higher grounds it seldom reaches the mountain top Were it not for the fact that Eastern North America is the only natural home of our most valuable hickories it would hardly be worth while or fair to place them among our most important trees In fact their approaching scarcity in connection with their easy reproduction is their strongest claim to notice here As a rule all the species of hickory demand a good soil—even though it may be on a hilly surface

Black walnut has been of importance It is practically exhausted now During the season a travel I have seen almost none remaining that was fully matured

The white walnut grows along streams even high up on the mountain side but the black walnut seldom is found in a thriving condition among the rocks of the higher steeper slopes This tree (black walnut) appears to grow equally well on limestone soils and on alluvial flats Though it seems to be as averse to the Oneida and Medina sandstone regions as the rock oak chestnut and locust are partial to them

IV RATES OF GROWTH OF MOST IMPORTANT KINDS OF TIMBER

The rates of reproduction and of growth in this country are both a surprise to a foreign forester It is with the latter of these that we are chiefly concerned for the mere reproduction of seedlings is as a rule so vastly in excess of what the ground can support that the question is narrowed down to rate of growth of the surviving trees

It is fair to lay down the general propositions that growth in height of our more important species is mainly a question of environment and that wood production attains its yearly maximum about the close of the second third of the average life of the tree

The first of these important propositions bears probably less upon the weight of the adult tree than it does on the character of the main trunk and on the spreading of the more important branches In other words that the towering white pine, white oak or tulip poplar which has grown up in a dense forest has probably about the same quantity of wood in it that the more spreading specimens of the same species would have when grown in more open ground

To illustrate the importance of the second proposition that the maximum wood production is about the close of the second third of the tree's life let us for a moment consider the relative values of one fourth of an inch of new wood around a stem whose diameter is six inches and one whose diameter is twenty four inches, the proportion would be as eighteen is to seventy two, or to reduce it to a decimal, the annual wood production of the smaller stem would be but twenty five per cent of the larger

There is no species of tree whose rate of growth is independent of environment. In Germany fifty cubic feet of wood is reckoned a large annual production for an acre. In this country there are abundant facts to prove that from one hundred to one hundred and twenty five cubic feet is not unusual for the same time and on a like area.

To bring the question to a more practical presentation it is fair to say that the average annual growth of a white oak on our mountain sides is between one sixteenth of an inch and one eighth. A tree of the same species growing on the alluvial flats of the lower Delaware or Susquehanna would show an average year's growth of from one eighth to one fourth of an inch. The rock chestnut oak on the rocky side of a mountain will probably require from eighty to one hundred years in Pennsylvania to attain a diameter of one foot. The same species of tree I have known to reach the same size in forty five years on better soil. Our common black oak illustrates the same principle in the lifetime of one and the same tree. Thus there are specimens in Centre county which grew with the average rapidity of the species for say forty years and then suddenly ceased to grow and began to die at the top because their roots had reached a bed of limestone just beneath the surface of the soil. So too I have in mind specimens of white and scarlet oak which under favorable conditions kept pace in growth with sugar and silver maples near which they were planted.

A second growth sprouting from vigorous stumps develops much more rapidly than the original growth where the roots were smaller in proportion to the trunk. This explains the peculiar strength and value for certain mechanical purposes of the second growth white oak in the rich lands of Indiana and Illinois. It is simply an illustration of the statement already made that the larger year's growth made a better lumber than the smaller (in the same species).

As a rule we may say that a century will be required to mature white pine hemlock and the hickories. The oaks will require half as much longer time. Chestnut may be regarded as making a fair body of mature wood in seventy five years.

V OBSTACLES TO THE GROWTH OF TIMBER

(a) *Natural Obstacles*

These have been in part anticipated by the statements already made. Among these poverty of soil may be regarded as first in importance. This, however is connected with an induced poverty due to removal of an earlier forest growth whereby on the steeper slopes the soil is washed away more rapidly than it is renewed. Indeed one philosophical observer has stated that if the forests were removed from our Pennsylvania mountains and they allowed, for any considerable time, to remain without trees, that reforestation would be practically impossible. Whether this statement is, or is not, true as a scientific principle, it may at least be allowed that the difficulties of producing a new forest growth would be infinitely increased Fortunately we are to a very great extent exempt thus far from the fungal and insect foes which have produced such serious havoc in Central Europe It is however within the limits of probability that there may come a time when this immunity will cease For example in the Adirondacks certain of the cone bearing trees have to a limited extent been injured by the fungus which produces the clustered branches known as witches brooms and in Fulton county of this State one or more small species of beetles have within the last three years killed considerable bodies of pitch pine by burrowing beneath the bark and destroying the young cambium layer on which the life of the tree depends It is estimated that in West Virginia these same insects have destroyed $1 000 000 worth of timber in the last four years * It is interesting to note that an insect antagonistic to these beetles has been found in considerable numbers on the infested trees To what extent they may succeed in holding the beetle in check remains to be seen The most promising plan of treatment would seem to be to cut and burn every infested tree The fact that thus far the insect invasion has been slow and affecting only isolated clumps indicates the possibility of successfully heading it off if dealt with promptly

The natural tendency in this State is towards a spontaneous reproduction of forests This shows that the obstacles are neither numerous nor grave in character

(b) *Obstacles Due to Human Agencies*

The chief obstacle here is fire—operating now in one way and now in another—and caused by design often with malicious intent, or by accident on the part of an individual or by a passing train

Fire acts directly and indirectly to prevent the growth of timber

Thus directly it kills the seeds saplings and often mature trees such as the hemlock and the white pine

The most destructive fires are those which follow close upon the operations of the lumberman The débris left by him invokes the flame and furnishes the requisite fuel for it when once created One severe conflagration, especially if on a steep hillside may not only blight the promise of a coming crop of trees but may lead to the destruction of the soil to such an extent that almost no plant life can flourish And year by year the little remaining soil is carried away by the descending rain until restoration of forest growth seems almost impossible Instances of this condi

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* This note from Mr Charles W Johnson explains itself

There are several species of beetles destructive to the pines of West Virginia The principal ones are *Dendroctonus frontalis* or The Destructive Pine Bark Beetle *Tomicus calligraphus* and *Tomicus cacographus* the latter is the one we found in Fulton county The Clerus imported from Europe is the *Clerus formicarius* European Bark Beetle Destroyer ' The one we found in Fulton county is closely allied and is known as *Thanasimus dubius* tion occur near the head of Long Run in Clinton county and in portions of the Beech Creek region in Centre and Clinton counties

Fires are frequently created to destroy the young timber and to encourage the growth of grass for summer pasturage for cattle The writer saw one such instance during the past season where a most valuable body of young white pine was destroyed and it seemed morally certain that it was by a fire started in the interest of a score of vagrant cattle Of course the remedy for such a state of affairs might be prompt and sure Confiscation of such cattle by due form of law when found without permission on land of other parties would end once for all this burning There can be no doubt that a considerable percentage of forest fires is the result of absolute maliciousness Luzerne county of this State but a few years ago furnished numerous examples of what were doubtless to be attributed to this cause The cure here is by no means so simple as at first appears The remedy which seems most popular at present not only in this but other States is authorizing supervisors or other officers to call out men to suppress forest fires and paying them for their work has been found by actual trial in several counties of this State to be an inducement to create fires on unseated lands It is a humiliating admission but it is clear that those and other regions of our own Commonwealth are not sufficiently law abiding or observant of ethical principles to make this method practicable The enactment of rigid and severe penal statutes is a matter of doubtful value unless accompanied by a costly machinery to ferret out and bring offenders to justice Opening of fire lanes through the timber lands raises the question by whom shall it be done—at individual or at State expense? The same may be said of keeping them open There can be no doubt that well kept fire lanes do render suppression of such fires more easy even if they do not interpose a certain barrier to their spread It will probably become more and more clear that timber protection and production in this State will be effective and common just in proportion as it is made to the interest of the individual citizen to guard and plant trees Here we come back to the most general of all principles under a popular government that laws are strong and effective only when backed by public sentiment and this may only be surely attained by an appeal to individual interests This brings me to

VI RELATION OF THE COMMONWEALTH TO FOREST RESTORATION

The first duty of government is either to perpetuate itself or to lead up to some higher better form of government On this hangs not only the safety of vested rights and the safety of capital but the strongest incentives to individual thrift, industry economy and rectitude are found in the idea that property acquired may be transmitted under protection of a stable government There is no crime more unpardonable in the individual than the treason which strikes at the safety of the government Is the act by which the State endangers its own prosperity and perpetuity any less heinous? This reduced to its simplest terms is the issue now before the Commonwealth Already after but two hundred and fifty six years of civilized occupancy Pennsylvania is called upon to interfere in order to restore to a productive condition and to protect against extravagant use about one eighth of her area Failure to act promptly now and wisely will entail on the coming generation loss of resource individual suffering and increase of taxation to meet the demands of pauperism These propositions seem so clear in the light of present resources and prospective population that it is a waste of words to discuss them

There are at least three thousand square miles in this State to day whose only possible function is the production of timber There is at least an equal area of land now cleared impoverished and becoming poorer each year on which cultivation has been attempted and proven hopelessly unremunciative which should be covered again by a forest growth No other proposition promises anything Unless these six thousand square miles are kept in a productive condition they will be an absolute loss to the State and a continued menace to much of the productive farming land

The problem is one of great magnitude Two and only two lines of public policy are possible The first one is for the State to assume control of such areas The second is for the individual to be encouraged to make these areas productive under the stimulus of State direction and State aid Which shall it be?

Where an area is distinctly isolated and as yet in an unimproved condition in great part on general principles it might be wiser for the State to assume direct and absolute control of it because a far reaching policy could be inaugurated which would look to the largest results ultimately The necessity for such action would be more and more apparent if it could be shown that it was directly in the interest of the Commonwealth that the State should be the possessor of the land

The State of New York undoubtedly is in that position to day The wisdom of her acquiring an absolute right to the Adirondack region by just and legal extinguishment of all individual titles will depend upon no other condition than what use she makes of the land

The State of Pennsylvania is not so fortunately situated Her natural timber areas extend clear across from the northern to the southern border and almost bisect her territory Important railway lines run through her belt of natural timber lands Large rivers traverse them and thriving farms villages and towns occupy the choicest parts of these areas which as a whole may be designated as almost exclusively natural woodlands Clearly the State could acquire no righteous title, nor could she even if ownership were possible, administer an estate so broken and disconnected in an economical manner

The remaining alternative is to recognize the fact that protection and utilization of these regions is of the first importance to the Commonwealth and to make it the interest of the citizen to serve the State To this proposition it is thought no one will object But at present the State and the individual are absolutely at cross purposes so far as the timber lands are concerned The township demands taxes for a protection which is not accorded for improvements which it does not make and for profits which the owner does not receive The facts are at hand to show that in certain portions of the State timber land which has yielded the owners nothing for thirty years has in that period paid more in the way of taxes than the land could be sold for to day Is it strange that to save themselves the owners of such lands should remove the timber and realize what they can then abandon them rather than pay the taxes? This same timber would be worth much more to the owner if allowed to stand The township which drives the man to remove this timber then to abandon the land loses at once taxes for present use and resources of future value It requires no argument to prove that this is a false policy

We will briefly consider the results of a removal of taxes from timber land

In the first place it would confer new value on these lands Owners would instead of wholly abandoning them at least retain them Retaining them even uncared for there would something of value grow upon them Here and there a tree often a young growth of forest trees and what was of no value would come now to have a positive value, however small The owner would have an interest and what applies to the individual owner would apply to the community and the man who by accident or by design fired land which was producing something and costing nothing would soon be a marked person Public sentiment instead of looking almost with indifference on woodland fires would become actively interested in their suppression Fire laws would have what they do not now have, support, and the law which hitherto was a dead letter would become a living real thing So much gained as timber was becoming scarcer, the next inevitable step would be to increase the quantity of timber produced, to improve its quality and to diminish so far as possible the time required to mature it as well also as to make the maturing forest pay for its own maintenance

Here we have at once the germ of a forestry system It would have the further advantage of being a system developed in harmony with our own environment It is probable that in a quarter of a century we should be further on towards success than if we tried to adopt and adapt a foreign system to the conditions of a popular government

Not only would the steeper rocky hillsides respond productively to this new policy but at once another element would enter the problem Lands hitherto taxed as farm lands but which were unremunerative, under cultivation would be planted in trees And from being costly unproductive lands, become productive lands entailing no cost The barren hillsides of this generation would have their virgin fertility partly restored and by the time they were required to produce crops for the larger population half a century hence would be in condition to do so Then, when the average farms have become reduced in size and a better system of agriculture inaugurated we might hope they would be prevented even if cleared from relapsing into the unproductive condition in which they are found now Probably by that time timber growing as a legitimate branch of agriculture would be established among us, and they would be found to pay enough to warrant keeping them in timber

There are however, two sides to this question The Constitution of this State reads thus *Art iii Sec 7* The General Assembly shall not pass any local or special law exempting property from taxation

It furthermore *Art ix Sec 1* expressly declares that all taxes shall be uniform upon the same class of subjects within the territorial limits of the authority levying the tax and shall be levied and collected under general laws but the General Assembly may by general laws exempt from taxation public property used for public purposes actual places of religious worship places of burial not used or held for private or corporate profit and institutions of purely public charity

'*Sec 2* All laws exempting property from taxation other than the property enumerated shall be void

It will be seen from this that as timber lands are not in the favored classes their exemption from taxation was clearly forbidden

The Constitution however, distinctly recognizes the constitutionality of classification in persons and things to be taxed *Art ix Sec 1* already quoted expressly declares for it in the phrase all taxes shall be uniform upon the same class of subjects

It may be an open question whether or not it may be possible to claim exemption from taxes for timber lands on the ground that as they collected water from the State at large as they aided in retaining the fertility of the soil on land other than that of the forest owner, they were in fact and deed "objects of purely public charity, or lands used for public purposes," until the owner derived a revenue from them by the removal and sale of wood It is, however, clearly within the power of the General Assembly to place them in a class by themselves under a specified minimum rate of taxation because they are under different conditions of production and are wholly different from any other lands, and for the good of the Commonwealth require legislation different in character from any other lands 'Laws enacted in pursuance of such classification and for such purposes are, properly speaking, neither local nor special" It is equally clear that if tax were collected from such lands classified as a separate class it would be under a general law, which specified no individual, but dealt with a whole class of persons, all of whom were similarly conditioned

Then again, even if tax were removed, or greatly reduced on timber lands the whole problem would not be solved, because this would deprive many portions of the State, where an excess of timber over cleared land remains, of the funds required for current expenses This difficulty is a serious one, and unless the deficit be made good, would be an absolutely prohibitory objection to total or partial exemption of timber lands from taxation

Let us consider this problem from another point The water which turns our factory wheels and which is used by our larger towns and cities whence does it come? As a rule from forest covered hill sides in remoter parts of the State The mills towns and cities seldom pay anything for it until it reaches their seats The men who own the land pay the taxes and receive actually less from it than those who pay nothing for it Put the proposition in its baldest form The City of Philadelphia pays nothing for an element which is essential to its life and without which it could not endure a day until it reaches the city limits Another portion of the community is taxed that we may receive our water free Is this fair? The comparisons between air and water supply are not parallel No one is taxed for air we simply ask that these cases be made parallel by taxing no one for production of water It is not too much then to say that the State at large is the beneficiary of the wood lands Nor is it too much to ask that legislation be granted by which such counties of the State as endure a hardship by removal of taxes from their timber lands should be relieved by the State to the extent of their financial loss from this cause

When timber comes to be removed it ceases to be a purely public benefit It enters the domain of individual or corporate trade and should be taxed accordingly

It is becoming more and more clear that officials are required whose duty it shall be to direct suppression of fires and to ferret out offenders The law should be imperative that every magistrate in the Commonwealth should report through proper channels at each session of Court all he knows of forest fires since previous session It should be made a specific duty to any evasion of which a penalty in some form should be attached The State already allows annually a premium on trees planted thus For 1200 to the acre during the first ten years ninety per centum of the tax paid on the same ground providing said premium shall not exceed the sum of forty five cents per acre For the second period of ten years the premium is eighty per centum, providing that the premium shall not exceed the sum of forty cents per acre

For a third and final period of ten years the premium shall be fifty per centum, providing that the premium so paid shall not exceed the sum of twenty five cents per acre

During and after the second period of ten years, the land owner may thin out his trees to not less than 600 per acre "so long as no portion of the said land shall be absolutely cleared of the said trees"

Nurserymen or other tree salesmen are not included in the benefits of this act

Timber land which has been cleared may receive the same premium as above indicated, providing that notice has been given within one year from date of clearing of the owner's intention to maintain said land in timber, the number of trees per acre required is the same and on the other hand the privilege of thinning is the same as to time and number

It is quite remarkable that so few of those who might have taken advantage of this law have been aware of its place on the statute book The Commissioners of Schuylkill county have however paid to the Girard estate money due under the provisions of this act The precedent is therefore established and others may be expected to avail themselves of the benefits offered

It will be seen however that liberal as these premiums are they fail at the very period when there begins to be a temptation to cut and when the average tree is in the state of its greatest productiveness so far as the growth of wood is concerned The woodland owner may keep his domain constantly in condition to earn the government premium but he will produce no thoroughly good matured wood if he is encouraged to cut it at thirty years of age

These bounties mark an important advance in public sentiment on the forestry problem but they fall far short of the full measure of usefulness one might expect from a complete remission of taxes when such remission is based on an appreciation of the fact that public rather than private interest is most subserved by it

It is clear that the question of an extensive State Forest Reservation is one which cannot be much longer postponed That this is demanded not less in the interest of a pure abundant water supply than it is by the ordinary interests of forestry is no less clear and it almost follows as a matter of course that such reservation should be located on the water shed which supplies the largest quantity of pure water to the largest population In this view of the matter, the spot where such reservation should be is plainly indicated by the topography of the State It should be noted further that this reservation might be made equally available as a public sanitarium It cannot be too strongly or too often noted that it is a measure of wise statesmanship, to provide an outing ground where those who are physically below par may by a sojourn in the open air of a wholesome region find renewed strength for the duties of life This is suggested not on any basis of philanthropy or sentiment, but simply because it promises to reduce the number of those who otherwise might become charges on the Commonwealth

VII METHODS OF FOREST RESTORATION

This division might come more properly in a treatise on practical forestry Still it may be proper to make certain general statements here on the subject. So far as known, there are at present within the limits of the State but two areas which might with any degree of propriety be designated as illustrating forestry practice Both of these are managed as a portion of the City Trusts, and are located one in Schuylkill and the other in Centre county

Forest restoration in this Commonwealth should be mainly confined to two classes of ground—first that which is fit for nothing else and otherwise would be unproductive and second that which is worn out by unproductive agriculture and which would be more promptly and cheaply restored to virgin fertility by a return to primitive conditions It is probably a safe estimate as already indicated that there are not less than six thousand square miles of territory which belong to one or the other of these classes or to put the statement in another way about one eighth of the area of the State

It is well to urge that for the present and the immediate future public or private forest operations of a restorative character should be confined mainly to such native forest trees as make the most certain and speedy growth This would not necessarily exclude such trees as the oaks for under favorable conditions these may be classed as rapid growers when compared with related trees elsewhere

The most promising of the native trees would be white pine chestnut locust black walnut and on rich soil shellbark hickory and white oak Hemlock culture will eventually become a necessity to the Commonwealth but owing to its slow growth and its uncertain success had better not at present be urged White oak is a tree of wide growth and therefore not so immediately in danger of becoming below our actual wants in quantity Chestnut grows freely over a wide range of conditions in other words its natural tendency is to take care of itself These facts make white pine the one tree whose immediate culture is most promising and most needed How shall its restoration be most successfully undertaken? There are two methods which we may properly designate as the nursery method and the method in final position The former is probably not soon likely to become popular Hence the latter method is the one most certain to lead to successful results in this country The young trees of this species are sensitive as most cone bearing trees are to excess of sunlight It should be started under the shadow of an existing open forest cover which is soon to be removed To meet this condition, white pine seed should be sown when possible on a northern exposure in poor or at least in rather poor soil The mature cones may be gathered in the autumn kept in a cool dry place until spring when many of the winged seeds will be found to have escaped from the cones The remainder may be obtained by shaking or breaking the cones Early in the spring the sooner after the frost comes out of the ground the better, the leaves of the open woods should be lightly raked from the soil in spots so as to give the seeds a chance to come in contact with the soil or at least with the damp leaves Then cover the seeds lightly with a rake This is rendered necessary by the fact that though the seeds of the white pine are well enough adapted to dispersion they are not so well suited to self-planting and many must fail of growth because they do not come in contact with a suitable substratum When the young pines are three or four years old the sheltering forest will have done its work and may be removed at any time

It should be remembered that the cone bearing trees are social in character and hence do better in dense groves In fact, one may also say dense planting is an essential condition upon which rests the production of the best pine timber It is probable enough that starting white pine in nurseries will some day come to be here, as elsewhere, the more common method, but it involves too much labor and care to recommend it at this stage of the Forestry Idea in the United States, or certainly, at least, in Pennsylvania.

Black walnut will always have a special value, and to make the idea more clear, it should be added that this value will depend on the character of the individual log There are in this State thousands of acres of fertile river bottoms where agriculture has been practically abandoned because of the frequently recurring freshets, on which the black walnut would not only grow rapidly, but where it might be depended upon to produce a good quality of lumber This tree does not, at first, grow rapidly on a soil of stiff limestone clay.

There is no surer way of starting the black walnut than to allow the fruit to remain out over winter under a slight cover of leaves When spring comes it will probably be found that the frost has opened the fruit so that a prompt start that spring may be expected. As the black walnut does not bear transplanting well, it is better that the nuts should be planted where they are to remain.

All that has been said of the method of starting the black walnut applies to the shellbark and hickory as well.

The white oak is worthy of a moment's consideration. It grows with great certainty from good acorns, and may be planted in drills as soon as collected If one thinks it really worth while to have his trees in the best condition for a vigorous start when finally transplanted, it is a good policy to lift and replant the young oaks at least twice before they are placed in permanent position. Good soil should be insisted upon as a cardinal point in white oak planting. If poor soil is to be occupied by oaks let the planting be of rock oak, providing the soil is well drained All that has been said as to starting the white oak applies as well to starting the rock oak. The same may be said of the chestnut.

Our common locust tree, it is not generally remembered, is a native of the mountain sides of this State. This fact should suggest the extreme value it possesses in reclothing those steep, poor regions with a timber whose value will always be appreciated. It has the further fact in its favor, once fairly started, it resists better than almost any other species of our trees, the periodical scorchings it receives from the spring and autumn fires.

Further consideration of this topic from the practical standpoint would be out of place here.

Association The Dominating Need of Man and the Keynote of Social Science

By Henry Carey Baird

(Read before the American Philosophical Society, March 16 1894)

Never before to day in the history of the human race has there been so earnest or so widely extended an examination of economic problems At this very hour the philosophers of the orthodox political economy and their philosophy are on trial before Christendom and the issue is not Is the philosophy true or is it false? But rather Is it or is it not so false and pernicious that when applied to human society that society is wholly unable to stand the strain and is constantly as a result in danger of wreck?

Social Science is fast emerging from that place wherein it has long been the plaything of school men who acknowledge themselves as being the teachers of a science based on assumptions Soon these teachers will be classed as mere metaphysicians whose disquisitions can lead to no beneficent practical end and their learned treatises will finally be consigned to that great lumber room of the centuries which holds the larger part of the literature of the world the forgotten because useless books Empires kingdoms republics even society itself trembles in the balance and these philosophers of assumptions have held the leading role in the terrible drama which places all of these human institutions in peril

Therefore does it seem fitting that so venerable and so renowned an institution as the American Philosophical Society should give some heed to the consideration of these vital problems Hence do I ask your attention to

Association The Dominating Need of Man and the Keynote of Social Science

OF SOCIAL SCIENCE

In science the most important preliminary work is that of definitions, in order that the exact meanings of words may be distinctly understood, and when so understood that those words shall always be used with the same significance Social Science treats of man in his efforts for the maintenance and improvement of his condition, and as defined by the Master, Carey is 'The science of the laws which govern man in his efforts to secure for himself the highest individuality and the greatest power of association with his fellow men " This definition is not only broad and comprehensive, but it points unmistakably to the true direction in which we must look for the investigation and solution of each and every principle in social science It uncovers and lays bare the very tap root of the science itself

THE FUNDAMENTAL PRINCIPLE

From this definition it is but one step to the fundamental principle and this principle as enunciated also by the Master is as follows

Man the molecule of society is the subject of social science In common with all other animals he requires to eat drink and sleep but his greatest need is that of *association* with his fellow men Born the weakest and most dependent of animals he requires the largest care in infancy and must be clothed by others whereas to birds and beasts clothing is supplied by nature Capable of acquiring the highest degree of knowledge he appears in the world destitute even of that instinct which teaches the bee and the spider the bird and the beaver to construct their habitations and to supply themselves with food Dependent upon the experience of himself and others for all his knowledge he requires language to enable him either to record the results of his own observations or to profit by those of others and of language there can be none without association Created in the image of his Maker he should participate in His intelligence but it is only by means of ideas that he can avail himself of the faculties with which he has been endowed and without language there can be no ideas—no power of thought Without language therefore he must remain in ignorance of the existence of powers granted to him in lieu of the strength of the ox and the horse the speed of the hare and the sagacity of the elephant and must remain below the level of the brute creation To have language there must be association and combination of men with their fellow men and it is on this condition only that man can be man on this alone that we can conceive of the being to which we attach the idea of man *

ALL SOCIAL SCIENCE MUST START FROM THE LAW OF ASSOCIATION

All true social science must of necessity start from this point It can start from none other and any system which attempts to ignore this fundamental principle as such is false in its inception and must of necessity be false throughout There is no escape from this dilemma The all controlling condition which governs man in this world is that which obliges him to associate and combine with his fellow men Literally from the cradle to the grave it controls his destiny and is at the bottom of all of the motives which throughout his career impel him to action He is thus insufficient unto himself and the higher his civilization the greater become his wants and therefore the greater his dependence on his fellow men and the more rigid and unyielding over his daily his hourly life the domination of the law All social science is concerned about it , and without it there would be no social science, no political economy no wealth, no poverty no money no banks no interest, no credit, no landlords no tenants no states, no cities no towns no villages no governments, no taxes no emperors, kings or presidents no armies no navies no generals no admirals, no steamships, no railroads, no mails no post office no corporations no shops no trade no commerce no colleges no schools no poets no historians no history no literature no science no philosophy no language no professors no doctors no lawyers no laws no society but each and every man and woman would be a law and a power unto himself or herself and so would every child from the moment of its birth to the hour of its death Indeed the entire life of each and every human being would be different from what it now is and no one would have any occupation whatever except that of looking after his or her necessities Thus would each and every one of these human vegetables live grow and flourish like any other vegetable independent of his fellow vegetables In fact the human animal of many of the economic philosophers partakes more of the nature of the vegetable than of that of the human being known as *man* because this philosopher has ignored and dropped out of his system the very quality which most characterizes and controls man and which most separates him from the lower forms of life both animal and vegetable

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* Carey *Principles of Social Science*, Vol I p 41.

WEALTH AND POVERTY WHAT ARE THEY?

What then is it that men struggle for and worry about live wear out and die to obtain and retain under the name of individual wealth? It is simply the power to associate with to command the services the commodities and the ideas of the largest body of men What then is individual poverty? The absence of the power readily to command those services commodities and ideas Thus whether he be prince millionaire or pauper man perishes of cold of heat of hunger of thirst of want unless he can bring himself into association with his fellow men To sum up the life of man is but a series a net work a complication of acts of association to cease the performance of which acts is of necessity to cease to live

DIVERSITY

The question now arises How is this power of association to be developed? Primarily by means of a diversity in the capabilities, employments productions and wants among the people constituting society to the end that there shall there exist the greatest number and the most powerful societary positives and negatives attainable or conceivable To accomplish this the consumer must be brought to the side of the producer the plough the loom and the anvil the farm the factory, and the workshop existing and growing up alongside of and in harmonious relations each to the others, giving and receiving blessing and being blessed Thus and thus only can labor power the most perishable of all commodities be utilized on the instant of its production and crystallized into work the basis of all wealth, individual and national No foreign commodity is therefore cheap or desirable to a people, no matter how low its price, while the labor at home is going to waste which might be employed in its production Hence the necessity for every people to build up thoroughly diversified industries at any cost and any sacrifice of present apparent cheapness On this impregnable rock does the protectionist plant himself and defy the enemy be he philosopher or be he boor

MONEY THE INSTRUMENT OF ASSOCIATION

By means of the brilliant, all pervading sunlight which the recognition of the true place held by the law of association at the very foundation of society sheds upon the societary problem the function of money assumes a new position and the accumulated rubbish of centuries which has covered up and obscured it is completely brushed aside In no other direction than that of the appreciation of the life giving function of money that of ministering to man's need for association and combination with his fellow men can we so confidently look for the emancipation of man himself

Starting from the basic law of association the Master has happily termed money *the instrument of association* and it thus ceases to be the dead inert thing which it has so long been supposed by the Greshams the Smiths, the Humes, the Ricardos the Huskissons the Peels the Overstones the Mills the assumption economists generally and the army of so called 'statesmen,' to be Money as the instrument of association becomes a vitalizer a producer a utilizer of human labor power a large volume of money thus under certain circumstances, being quite consistent with cheap production, as will be made more apparent in the sequel Acknowledgment of the law of association as a basis furnishes the *only* rational means of accounting for a host of problems touching money which are of everyday occurrence and observation although in direct antagonism to the theories of the philosophers

The daily life of a civilized people, involving such countless millions of acts of association or commerce such myriads of compositions decompositions and recompositions of services, commodities and ideas, a medium having the qualities of universal acceptability and of almost unlimited divisibility and aggregation is absolutely necessary to that life In the early stages of society, and in isolated communities there is but little societary life, and there man is dependent upon but comparatively few of his fellow men, while in a city like London, Paris, New York Philadelphia or Chicago there are many thousands of individuals each of whom daily calls for the services of millions of men Indeed, the purchaser of a copy of the *Herald*, *Tribune* *Press* or *Ledger*, in making that purchase calls for the services of the millions of men who have, in any way, contributed to the production of one of these papers, even so remotely as by making the material of which the railroads or telegraphs have been constructed, by means of which the raw materials of the newspaper and the news have been conveyed all the way through from the miners of the coal, and the smelters of the metals in the machinery used in its production, to the makers of the paper and the type, to the compositors, press-men editors distributors etc etc From the standpoint and through the luminous ether of the law of association or commerce as at once the centre the circumference the foundation the all pervading spirit of social philosophy the study of the millions on millions of compositions decompositions and recompositions of services commodities and ideas involved in a pile of a single issue of a great daily newspaper is indeed the study of and the royal road to the mastery of the best part of social philosophy itself

LABOR POWER

It cannot be too fully too distinctly too forcibly impressed upon the mind that it is the utilization of labor power which ameliorates the condition of mankind creates wealth and causes the wide and just diffusion of that wealth Such utilization is indeed the one and only basis of individual well being and of national power and civilization It is in a word the single road which leads to the emancipation of man

The life of a civilized people thus involving countless millions of acts of association or commerce the absolute condition on which these acts can be performed and the labor power involved in these acts be utilized is an abundance of the medium *money* with its quality of universal acceptability and which thus acts as a saving fund for labor and by facilitating association and combination gives utility to billions of millions of minutes that would be wasted did not a demand exist for them at the moment the power to labor had been produced

Thus was it the law of association which dominating the life of man caused in the far off ages the institution of money It being an absolute necessity growing out of man s nature It had to be it must now be it will ever be while man inhabits the earth and it can find no philosophical explanation except through the recognition of the supreme and all controlling law of association between man and his fellow men On this ground the greenbacker and the silver man can take their stand and defy all adversaries On the broad foundation rock of association the protectionist and the greenbacker and the silver man can alone come into harmonious relations and associative coöperation

ASSOCIATION AND THE POWER ARISING FROM ITS CONTROL

Scattered isolated men are always feeble and powerless for great undertakings because of the absence of ability to exchange services commodities and ideas to associate with their fellow men On the other hand the most powerful men in the world are those who centre round the exchanges or bourses of New York London Paris Berlin Amsterdam and Vienna The great power of these men arises from the fact that while having great ability to associate among their several selves by control of the instrument of association money and its greater representative credit they control the power of association among hundreds of millions of men women and children throughout the world It is even in the power of these dictators largely to arrest association among mankind and they do it

HOW MAN OBTAINS CONTROL OVER NATURE

With the high development of the power of association in advancing communities the forces of nature are more and more harnessed into the uses of man taking the place of human bone and muscle and even of the bone and muscle of animals three tons of coal representing the labor of a man for his entire life

Thus while the animal force expended in the conversion of raw products into finished commodities decreases in proportion to the total volume of conversion the money cost of that conversion also decreases At the same time raw products including land and labor which before had no value being now utilized acquire value So by a beautiful and compensating law land labor and other raw products rise and finished commodities fall The laborer thus by virtue of the Master s law of distribution obtains a larger proportion of a larger yield and acquires growing freedom and independence With these advances man is steadily obtaining the power to call to his aid better and more efficient tools among which none is more important than land At first weak with but little power of association he is able only to cultivate the light sandy soils and those at the heads of rivers or the dry and slightly wooded ones on the sides of the hills Only as he is able to command the services of his fellow men is it that he obtains power to cope with the wet rich and heavily timbered lands of the valleys reeking with malaria and requiring drainage

THE MOVEMENTS OF MONEY

Having considered the effects of the instrument of association on association let us now see how association affects the movements of the instrument itself

Money *leaves* those places where there is no diversification of employments and where money is scarce and interest high where land labor and other raw materials are cheap and where finished commodities are dear It *goes* to those places where industries are diversified and where money is plenty where bank credit is large in volume and interest is low, where land labor and other raw materials being utilized are high and where finished commodities through the intervention of brains, chemistry electricity steam and machinery are as well as interest low In a word, money travels *from* those places in which the power of association is not developed *to* those in which it is in the highest degree developed Thus with the growth of the power of association wealth, freedom contentment harmony and civilization are established society assuming an ever broadening base, with a stability which finally eliminates discontent and lawlessness

THE GREAT AND SUPREME LAW OF ASSOCIATION

Hold up the law of association among men, and view it from any of its countless sides, and the more closely it is studied the more it shows itself to be to the world of humanity what the law of gravitation is to the world or universe of matter It is the philosopher s stone which transmutes clears up the temporal mystery of man This law dogs the outcast and the beggar whose conditions preclude the possibility of active association It places the offensive weapon in the hands of the modern boycotter it says to the man who is tempted to go wrong Go not for society will cast you out It induces the laborer to toil it spurs the mechanic and the artisan to become masters of their respective trades it causes the student to burn the midnight oil and the doctor the lawyer the professor to spend years in acquiring and imparting knowledge The business man who struggles night and day to avoid bankruptcy does so that he may retain that financial credit which enables him to swing a power of association far in excess of that which his capital would give This law has its most beautiful manifestation in the family with its tender loving and self sacrificing ties of father mother and children

Men build railroads steamships steamboats and hotels and other men work them because of this law of association the banker organizes his bank that he may control association and profit by it governments impose taxes that they may call civilians soldiers and sailors into association with themselves An army is an armed association under officers who hurl it regardless of life or death against other armies in order that another association called the state may live and flourish and that its citizens or subjects may associate exchange services commodities and ideas among their several selves The post office with its machinery for the transmission of letters and printed matter and its postage stamps and money orders and the express in all its details including C O D are all outgrowths of the supreme law of association

CONCLUSION

Social Science concerning itself with the relations of man to his fellow men and to the earth which he inhabits and Association being the Dominating Need of Man in these relations, it follows that Association must be the Keynote of Social Science Therefore the touchstone for every economic problem is its relation to Association There is and can be no other test for it and if it cannot pass this ordeal it must be rejected as false and pernicious

When once the believers in the necessity for the fullest diversification of our industries and those others who believe in a volume of money, whether of gold silver or paper or of all of them equal to the needs of trade and commerce place themselves firmly on the basis of the law of association for their justification they will instantly and for all time direct the industrial and financial policy of this people

And now, once more, we come back to the words of the Master

"*Man, the molecule of society, is the subject of social science In common with all other animals he requires to eat, drink and sleep, but his greatest need is that of* ASSOCIATION *with his fellow men* "

Stated Meeting January 19, 1894.

President, Mr Fraley, in the Chair

Correspondence was submitted as follows

Invitation from the West Virginia Historical and Antiquarian Society, Charleston, W Va, to attend the Fourth Annual Meeting, Tuesday, January 16, 1894

Letters of envoy were received from the Australasian Association for the Advancement of Science, Hobart, Académie R des Sciences, Stockholm, Sweden, Société R de Geographie d Anvers Belgique, K Leopoldinisch Carolinische Deutsche Akademie der Naturforscher, Halle a S, Prussia, K Sächsische Gesellschaft der Wissenschaften, Leipzig Faculté des Sciences, Marseille, France École Polytechnique, Musée Guimet, Paris, France, Geological Survey of New Jersey, Trenton, Mr Henry Carey Baird, Philadelphia, Société Scientifique du Chile, Santiago

Letters of acknowledgment were received from the Royal Society of N S W (140), Linnean Society of N S W, Sydney (139 140) Royal Geographical Society (Queensland Branch), Brisbane (140), Royal Society of Victoria, Melbourne (140) Free Public Library, Wellington, N Z (134, 136), Société Royale de Geographie d Anvers, Belgique (131, 132, 140, 141), Prof Peter R von Tunner, Leoben, Austria (140, 141), Deutsche Geologische Gesellschaft, Berlin, Prussia (136, 141, and Trans, xvii, 3, xviii, 1), Verein für Erdkunde, Dresden, Saxony (141), Physikalisch Medicinische Gesellschaft, Erlangen, Germany (141), K Leopoldinisch Carolinische Deutsche Akademie der Naturforscher, Halle a S, Prussia (136–141, and Trans, xvii, xviii, 1), Deutsche Seewarte, Hamburg, Germany (136, 141), Prof L Rutimeyer, Basel, Switzerland (141), Schweiz Naturforschende Gesellschaft, Bern, Switzerland (141), Société Vaudoise des Sciences Naturelles, Lausanne, Switzerland (141), R Accademia di Scienze Littere ed Arti, Modena, Italy (140, 141), Società Africana d'Italia, Naples (141), Accademia di Scienze Littere ed Arti, Padua, Italy (140, 141), Prof G Sergi, Rome, Italy (141), Geological Society, London, Eng (140), Botanical Society of Canada Halifax, N S (141) Vermont Historical Society, Montpelier (139) Prof W T Hewett, Ithaca N Y (140), Newberry Library Chicago, Ill (140, 141) Instituto Fisico geografico Nacional San José de Costa Rica, C A (139 140)

Accessions to the Library were reported from the Académie R des Sciences, Stockholm, Sweden Académie R des Sciences, Bruxelles, Belgique, Nederlandsche Maatschappij Nijverheid, Amsterdam, Koloniaal Museum, Haarlem, Noord Holland, Académie des Sciences, Cracow, Austria, Naturforschende Gesellschaft des Osterlandes, Altenberg, Oberlausitzer Gesellschaft der Wissenschaften, Gorlitz, Biblioteca N C, Firenze, Italia, R Accademia dei Lincei, Rome, Italy, Académie N des Sciences, etc, Bordeaux, France Société Historique, etc, du Cher, Bourges, France, Société de Borda, Dax, France, Union Geographique du Nord de la France, Douai, Société de Géographie, Lille, France, Faculté des Sciences, Marseille, France, Redaktion *Cosmos*, Société de Geographie, Musée Guimet, Société de l Enseignement, École Polytechnique, Société d'Anthropologie, Redaction de *La Melusine*, Société des Antiquaires de France, Directeur of the *Revue des Revues*, Marquis de Nadaillac, Paris, France, Société de Géographie, Toulouse, France R Academia de la Historia, Madrid, Spain, Naturforschende Gesellschaft, Basle, Switzerland, Philosophical and Philological Societies, Cambridge, Eng, Editor of the *Geological Magazine*, Royal Geographical Society, Meterological Council, Royal Microscopical Society, London, Eng, Geological Society, Manchester, Eng, Prof F Max Müller, Oxford, Eng, Philosophical Society, Glasgow, Scotland, Dr Samuel A Green, Boston, Mass, Mr William John Potts, Camden, N J, Franklin Institute, Engineers' Club, Drs George Friebis, Walter M James, Charles A Oliver, Messrs Henry Carey Baird, William S Baker, Henry Phillips, Jr, Philadelphia, Johns Hopkins University, Baltimore, Md, Bureau of the Mint, National Academy of Sciences, Hydrographic Office, Washington, D. C.; Mr. William Harden, Savannah, Ga.; Mr. George W. Baily, Cedar Rapids, Ia.; Colorado Scientific Society, Denver; Agricultural Experiment Stations, Concord, N. H.; Amherst, Mass.; Ithaca, N. Y.; College Park, Md.; Agricultural College, Miss.; Manhattan, Kans.

A photograph of Prof. John Tyndall, London, Eng., was presented by Mr. F. Gutekunst, Philadelphia.

The President reported that in accordance with the resolution of the Society he had appointed Dr. Daniel G. Brinton to prepare the obituary notice of the late George de Benneville Keim.

The death of Oswald Seidensticker (born Gottingen, 1824; died, Philadelphia, January 10, 1894), was announced and the President was authorized to appoint a suitable person to prepare the usual obituary notice.

The election for Librarian was taken up and Mr. Henry Phillips, Jr., was unanimously reelected Librarian for the ensuing year.

The President was authorized to appoint the Standing Committees, which he subsequently did, as follows:

Finance.—Philip C. Garrett, Charles S. Wurts, William P. Tatham.

Hall.—J. Sergeant Price, William A. Ingham, Charles A. Oliver.

Publication.—Daniel G. Brinton, George H. Horn, Samuel Wagner, Patterson DuBois, Horace Jayne.

Library.—Edwin J. Houston, Jesse Y. Burk, William H. Greene, William S. Baker, Albert H. Smyth.

Michaux Legacy.—Thomas Meehan, William M. Tilghman, J. Sergeant Price, Angelo Heilprin, William Powell Wilson.

Henry M. Phillips Prize Essay Fund.—Richard Vaux, Henry Phillips, Jr., William V. McKean, C. Stuart Patterson, Joseph C. Fraley, and the President and Treasurer of the Society, *ex officio*.

The Secretaries presented for the Transactions a bacteriological study of the water supply of Philadelphia, by Dr. Wright. On motion, the same was referred to a Committee of three members to be appointed by the President, to examine and report upon

Mr Lyman read a paper on the 'Age of the Newark Brownstone'

Pending nominations Nos 1268 1269 1270 1271 1272 1273, 1274, and new nomination No 1275 were read

And the Society was adjourned by the President

Stated Meeting February 2, 1894

President, Mr FRALEY, in the Chair

Correspondence was submitted as follows

A circular inviting subscriptions towards a memorial bust of Prof Ernst Hæckel, to be placed at Jena, on February 17 1893

A circular from the Council of the Scientific Alliance of New York inviting contributions to the John Strong Newberry Fund for the Endowment of Original Scientific Research

Photographs for the Society's Album were received of Prof Oswald Seidensticker and Prof J P Lesley, Philadelphia, Prof Justin Winsor, Cambridge, Mass

The deaths of the following members were announced

Rev John Leyburn (Baltimore, Md), died July 13, 1893, æt 78

Prof William P Trowbridge (New York), 1893

Accessions to the Library were reported from the Comité de Conservation des Monuments de l Art Arabe, Cairo, Egypt, Royal Society of Victoria, Melbourne, Linnean Society of New South Wales, Sydney, Société R des Antiquaires du Nord, K Norske Oldskrift Selskab, K D Geografiske Selskab, Copenhagen, Denmark, Director of the R N Museum of Antiquities, Leiden, Holland, K K Geologische

Reichsanstalt, Vienna, Austria; Botanische Verein der Provinz Brandenburg, Berlin, Prussia; Sächsische Meteorologische Institut, Chemnitz; Gartenbauverein, Darmstadt, Germany; Naturwissenschaftliche Verein des Reg. Bez. Frankfurt a. O, Prussia; Prof. E. Renevier, Lausanne, Switzerland; R. Accademia, Modena, Italy; Société de Geographie, Toulouse, France; R. Academia de Ciencias y Artes, Barcelona, Spain, R. Irish Academy, Dublin; Sir J. William Dawson, Montreal, Canada; American Folk Lore Society, Dr. Samuel A. Green, Boston, Mass.; R. I. Historical Society, Dr. H. T. Cresson, Providence, R. I.; Agricultural Experiment Station, New Haven, Conn., Amer. Museum of Natural History, Amer. Geographical Society, Academy of Medicine, New York, N.Y., N. J. Historical Society, Newark; Amer. Pharmaceutical Association, Indian Rights Association, Messrs. William S. Baker, H. C. Mercer, W. L. Sayre, Philadelphia; U. S. Geological Survey, Mr. Lester F. Ward, Washington, D C.

The President reported that he had appointed Dr. H. V. Hilprecht to prepare the obituary notice of the late Dr. Seidensticker.

The President reported the appointment of Dr. Ryder, Dr. Barker and Mr Bache as a Committee to examine and report on the paper by Dr. Wright, presented at the last meeting of the Society.

The Committee on Dr. Wright's Paper on the "Water Supply of Philadelphia" reported the same to be worthy of publication. On motion, the Committee was discharged and the paper referred to the Publication Committee.

Dr. Cope presented a paper on "The Structure of the Skull of the Plesiosaurian Reptilia, and on Two New Species of this Order from the Upper Cretaceous."

Dr. Cope also presented a paper by Prof. A. T. Chamberlin on "Botanical Names in the Language of the Kootenay Indians of Southeastern British Columbia."

Pending nominations Nos. 1268, 1269, 1270, 1271, 1273, 1274, 1275 were read.

Nomination No. 1272 was withdrawn by its proposer.

On motion of Mr Smyth, the Society appointed Messrs Daniel G Brinton and Henry Phillips Jr delegates to the meeting of the Congres International des Américanistes to be held at Stockholm in September, 1894 providing that the same shall not entail any expense upon the Society

The question of permitting persons connected with the public press to be present at the regular meetings of the Society, for the purpose of reporting the same for publication, was brought up by the Secretaries and after considerable discussion the following resolution offered by Dr Daniel G Brinton was unanimously adopted

That the Society disapprove of the presence of professional reporters in their business capacity at the regular meetings of the Society

And the Society was adjourned by the President

Stated Meeting February 16, 1894

Mr INGHAM in the Chair

Letters of envoy were received from the Geologische Reichsanstalt Vienna, Austria, Naturforschende Gesellschaft des Osterlandes, Altenburg, Germany Verein für Schlesische Insektenkunde, Breslau, Germany, Naturwissenschaftliche Verein für Schleswig Holstein, Kiel, Prussia, Royal Geological Society of Cornwall, Eng Royal Statistical Society, London, Eng, Royal Irish Academy, Dublin, Ireland

Letters of acknowledgment were received from the Institut Egyptien, Cairo (141), K K Geologische Reichsanstalt, K K Naturhistorische Hofmuseum, Vienna, Austria (141), K P Akademie der Wissenschaften (140), Botanische Verein d Provinz Brandenburg (187, 188), Berlin, Prussia, Verein fur Schlesische Insektenkunde, Breslau, Germany (189), Prof H von Helmholtz, Charlottenburg, Germany (139-141), Gartenbauverein, Darmstadt, Germany (189), K Sachsische Alter thumsverein, Dresden (141) Naturwissenschaftliche Verein des Reg Bez Frankfort a O (141) Naturwissenschaftliche Verein fur Schleswig Holstein, Kiel, Prussia (135–139) Institut Lombardo di Scienze e Lettere, Milan Italy Académie R des Sciences, Lettres etc Modena Italy (130 135 and Transactions, xvi, 3), Société des Sciences Naturelles et Archeologique de la Creuse Guéret, France (141) École Polytechnique, Dr Edward Pepper Paris, France (141) R Academia de Ciencias y Artes, Barcelona, Spain (139) Public Library, Boston, Mass (140) Prof F A Genth Jr, Lansdowne Pa (141), Dr William H Furness, Philadelphia (140, 141), Bureau of Ethnology, Washington D C (96–135 137, 138, 140, and Catalogue, Pts i iv), Wisconsin Academy of Sciences, Arts and Letters, Madison (119–141, and Catalogue, Pts i–iv)

Letters of acknowledgment (142) were received from Dr Charles B Dudley, Altoona, Pa , Dr Robert H Alison Ardmore, Pa , Prof James E Rhoads, Bryn Mawr, Pa , Mr Matthew H Messchert, Douglassville, Pa , Hon Eckley B Coxe, Drifton, Pa , Prof J W Moore, Rev Thomas C Porter, Easton, Pa , State Library of Pennsylvania, Mr Andrew S McCreath, Harrisburg, Pa , Mr John Fulton, Johnstown, Pa , Linnean Society, Lancaster, Pa Prof F A Genth, Jr , Lansdowne, Pa , Academy of Natural Sciences, Historical Society, Mercantile Library, College of Pharmacy, College of Physicians, Philadelphia Library, University of Pennsylvania, Editors of the *Medical News*, Wagner Free Institute, Gen'l Isaac J Wistar, Hon James T Mitchell, Profs John Ashhurst, J Solis Cohen, E D Cope, Henry D Gregory, L M Haupt, H V. Hilprecht, Edwin J Houston, E Otis Kendall, J. P Lesley, James MacAlister, Theophilus Parvin, Samuel P Sadtler, Benjamin Sharp, Albert H Smyth, Drs D G Brinton, W C Cattell, William H Furness, William H Goodell, Francis W Lewis, Morris Longstreth, John Marshall, Charles A Oliver, W S W Ruschenberger, Charles Schäffer, H Clay Trumbull, William H Wahl, Charles Stewart Wurts, Messrs R Meade Bache Henry Carey Baird, Charles Bullock, S Castner, Jr, Patterson Du Bois, William W Jefferis, Henry Phillips, Jr, Franklin Platt, Theodore D Rand J G Rosengarten, L A Scott, Coleman Sellers, Joseph Wharton, Joseph M Wilson Philadelphia, Mr Heber S Thompson, Pottsville, Pa, Rev F A Muhlenberg, Reading, Pa, Dr William Hyde Appleton Swarthmore, Pa, Dr John Curwen, Warren, Pa, Philosophical Society Mr Philip P Sharples, Prof J T Rothrock, West Chester, Pa

Accessions to the Library were reported from the Royal Geographical Society, St Petersburg, Russia, Ministerie van Binnenlandsche Sachen, The Hague, Verein fur Beforderung des Gartenbaues, Berlin, Prussia Verein fur Schlesische Insektenkunde, Breslau, Prussia, Naturwissenschaftliche Verein, Kiel Prussia, Royal Geological Society, Cornwall, Eng, Royal Statistical Society, Geological Society, London, Eng, Mr A McF Davis, Cambridge, Mass, Essex Institute, Salem, Mass University of the State of New York, Albany, Prof Edward North, New York, Philadelphia Hospital, Forestry Association, Prof George F Barker, Philadelphia, Enoch Pratt Free Library, Baltimore, Md, Bureau of Education Anthropological Society, U S Naval Observatory, War Department, U S Coast and Geodetic Survey, Treasury Department, U S Fish Commission, Smithsonian Institution, U S National Museum, Dr Albert S Gatschet, Washington, D C, Artillery School, Fortress Monroe, Va, Editor of the *Journal of Comparative Neurology*, Granville, Ohio, Michigan Board of Agriculture, Lansing, University of California, Berkeley, State Historical Society, Iowa City, Ia, State Historical Society, Madison, Wis, Kansas University, Lawrence, Asociacion de Ingenieros y Arquitectos, Observatoire Méteorologique Central, Observatorio Astronómico N. de Tacubaya, Mexico, Mexico, Muséu Nacional, Rio de Janeiro, Brazil, Agricultural Experiment Stations, Kingston, R I, Lexington, Ky, Lansing, Mich, Berkeley, Cal; St Anthony Park, Minn

Photographs for the Society's album were received from

Marquis de Nadaillac, Paris, France; Mrs. Helen Abbott Michael, Philadelphia

The following deaths were reported:

George W. Childs, Philadelphia, February 3, 1894, æt. 64.

Rev. Henry S. Osborn, Oxford, Ohio, February, 1894.

The President was requested to prepare a note to be entered upon the minutes of the Society in reference to the death of Mr Childs.

The Publication Committee reported that it would not be practicable to publish Dr. Wright's paper on the Water Supply. On motion the paper was ordered to be returned to its author.

The Secretaries reported that the paper by Prof. A F Chamberlin, entitled "The Botanical Names in the Language of the Kootenay Indians," was not desirable for publication

This being the evening for voting for candidates for membership, pending nominations Nos. 1268, 1269, 1270, 1271, 1275 were read, spoken to and balloted for.

Action on pending nominations Nos. 1273 and 1274 was deferred until May 18, 1894.

The proceedings of the Board of Officers and Council were submitted.

Dr. Cope made a communication on "Energy in Evolution"

Dr. Brinton read a letter from Mr. J. C. Pilling in reference to a desired exchange, and the matter was referred to the Secretaries with power to act.

At the end of the evening, the votes cast having been counted, the tellers reported the state of the poll to the presiding member, who declared that the following had been duly elected members of the Society:

No. 2227. Colonel Henry A. DuPont, Wilmington, Del.

No. 2228. Sir Henry Bessemer, London.

No. 2229. Dr. Hermann Snellen, Utrecht.

No. 2230. Julius F. Sachse, Philadelphia.

And the Society was adjourned by the presiding member.

Stated Meeting, March 2, 1894

President, Mr FRALEY, in the Chair

Mr Julius F Sachse, a newly elected member, was presented to the Chair and took his seat

Correspondence was submitted as follows

A letter accepting membership was received from Col Henry A DuPont, Wilmington, Del

A circular from the National Sculpture Society New York, requesting the Society to become a member of same

Letters of acknowledgment were received from the Hungarian Academy of Sciences, Budapest (138–141) Literary and Historical Society, Quebec, Canada (96–141, and Catalogue, Parts i–iv)

Letters of acknowledgment (142) were received from the Nova Scotia Institute of Science, Halifax, Mr Horatio Hale, Clinton, Ontario, Geological Survey, Ottawa, Canada, Literary and Historical Society, University Laval, Quebec, Canada, Canadian Institute, Toronto, Canada, Manitoba Historical and Scientific Society, Winnipeg, Bowdoin College Library, Brunswick, Me, Society of Natural History, Maine Historical Society, Portland, Me, Dartmouth College Library, Hanover, N H, Vermont Historical Society, Montpelier, Massachusetts Historical Society, State Library of Massachusetts, Boston Society of Natural History, Boston Athenæum, Prof T M Drown, Messrs S P Sharples, Robert C Winthrop, Boston, Mass, Museum of Comparative Zoology, Prof Alexander Agassiz, Mr Robert R Toppan, Cambridge, Mass, Essex Institute, Salem, Mass, Prof Elihu Thomson, Swampscott, Mass Dr James Ellis Humphrey, Weymouth Heights, Mass, American Antiquarian Society, Worcester, Mass, Rhode Island Agricultural Station, Kingston, Providence Franklin Society, Brown University, Rhode Island Historical Society, Providence, R I, Mr George F Dunning, Farmington, Conn, Connecticut Historical Society, Hartford, Yale University, Profs O C Marsh H A Newton, New Haven, Conn, Prof James Hall, Albany, N Y Society of Natural Sciences, Buffalo N Y Prof Edward North Clinton, N Y, Prof J M Hart, Ithaca N Y Historical Society, Academy of Medicine New York Hospital, American Museum of Natural History Meteorological Observatory University of the City of New York, Profs J A Allen Isaac H Hall, J J Stevenson, Messrs Thomas C Clarke Charles P Daly, James Douglas, New York N Y Prof W LeConte Stevens, Troy, N Y Vassar Brothers Institute, Poughkeepsie, N Y Geological Society of America, Academy of Science, Rochester, N Y, Oneida Historical Society Utica N Y Free Public Library, Jersey City, N J, Prof Robert N Rogers, Madison N J, New Jersey Historical Society, Newark, Profs Charles W Shields, Charles A Young Princeton, N J, Prof Charles F Himes, Prof Lyman B Hall, Haverford, Pa, Messrs Charles H Cramp, Louis Vossion Samuel Wagner, Mrs Helen Abbott Michael, Philadelphia, Smithsonian Institution, United States Geological Survey, Surgeon General s Office, United States Coast and Geodetic Survey, Weather Bureau Col Garrick Mallery, Prof Charles A Schott, Drs John S Billings, W J Hoffman, Mr William B Taylor, Washington, D C, Enoch Pratt Free Library, Maryland Institute, Prof Ira Remsen, Baltimore, Md, Mr Thomas Leiper Patterson, Cumberland, Md, Journal of the United States Artillery, Fortress Monroe, Va, Prof J W Mallet, University of Virginia, Elisha Mitchell Scientific Society, Chapel Hill, N C, Agricultural Experiment Station, Raleigh, N C, Georgia Historical Society, Savannah, University of Alabama, University P O, Texas Academy of Science, Austin, Agricultural Experiment Station, Knoxville, Tenn, Prof E W Claypole, Akron, O, University of Cincinnati, Cincinnati Observatory, Cincinnati, O, Editor of *The Journal of Neurology*, Granville, O, Gen W F Raynolds, Detroit, Mich, Geological Survey, Jefferson City, Mo, Purdue Experiment Station Lafayette, Ind, Society of Civil Engineers, Remington, Ind, Academy of Natural Sciences, Davenport, Ia, State Historical Society, Iowa City Ia University of California, Berkeley, Lick Observatory Mt Hamilton, Cal, Prof J C Branner Palo Alto, Cal, Prof Daniel Kirkwood, Riverside, Cal Prof George Davidson, San Francisco, Cal Kansas University Quarterly, Lawrence, Kansas Academy of Science, Topeka, Academy of Sciences Arts, and Letters State Historical Society, Madison, Wis, State Historical Society, Agricultural Experiment Station, Lincoln, Neb, University of Wyoming, Laramie Academy of Science, Tacoma, Wash, Lieut A B Wyckoff North Yakima, Wash Central Meteorological Observatory, Sociedad Cientifica "Antonio Alzate," Dr Antonio Peñafiel, Mexico Mexico Agricultural Experiment Station, Las Cruces, N M

Accessions to the Library were reported from the Royal Society of South Australia, Adelaide, Prof A W Bickerton Christchurch, N Z, Société Impériale des Naturalistes, Moscow, Russia, Académie Impériale des Sciences, St Petersburg, Russia, Section fur Naturkunde des O T C, Anthropologische Gesellschaft, Vienna, Austria K P Meteorologische Institut, Berlin, Prussia, Deutsche Gesellschaft für Anthropologie, etc, Munich, Bavaria, Ecole Nat Sup des Mines, Bureau des Longitudes, Société Francaise de Physique, Paris, France Philological Society, Cambridge, Eng, Geographical Society, Literary and Philosophical Society, Manchester, Eng, Massachusetts Institute of Technology, Boston, Mass, Harvard College, Cambridge, Mass, Scientific Association, Meriden Conn, College of Physicians, Historical Society of Pennsylvania, Messrs Henry Phillips, Jr, Frederick Prime, Philadelphia, Smithsonian Institution, Citizens' Association of the District of Columbia, Civil Service Commission, Washington, D C Prof Alexander Macfarlane, Austin, Texas, Historical Society of Southern California, San Francisco, Prof J P Walton, Muscatine, Ia, Institute of Jamaica, Kingston, Agricultural Experiment Stations, Amherst, Mass, Geneva, N Y, Experiment, Ga, Baton Rouge, La, Fort Collins, Colo, Las Cruces, N M

Photographs for the Society's Album were received from

Dr. George R. Morehouse, Messrs. William V. McKean and Robert Patterson.

Dr. Rothrock read a paper on "The Present Condition and Future Prospect of the Pennsylvania Forests."

Dr. Morris corroborated the destruction of timber by insects as referred to in Dr. Rothrock's paper.

Dr. Morris read the following communication on "Tuberculosis in Animals."

Some months since I was present at the slaughter of a herd of cattle on account of a dread of their being tainted with tuberculosis. This disease had been diagnosed as present in the original herd more than two months previously and all suspected animals had then been killed. The farmer, however, was not satisfied that the disease had been stamped out, and preferred to have the rest slaughtered while still in good condition for food as determined by experts who were present. In the lungs of two of them a few hard nodules were found, and on the intestinal walls of nearly all were small round masses which, on being incised, gave vent to a greenish gritty cheesy mass. In the opinion of the veterinary surgeon who was present these were not tubercular. They reminded me more of such small cheesy masses as are often found in human post mortem examinations and are apt to be disregarded unless found abundantly in subjects of true miliary tubercle, when we often consider them as proof that the disease has become disseminated through the entire organism. With these exceptions and also the occurrence of numerous vascular subcutaneous lymphatics (called "beans" by the butcher boys) the cattle showed no disease, but on the other hand compared favorably with some Western steers which were slaughtered at the same time. The veterinary above mentioned called my attention to the comparative absence of these "beans" and small yellowish white bodies in the Western grain fed stock and attributed their frequent or almost universal occurrence in Eastern cattle to something in the food or pasture grounds or water used by our cattle. This has set me to thinking whether there may not be some filaria or other intestinal parasite which causes such spurious cyst like formations. But while waiting for opportunity to investigate this more closely, a gentleman observed to me that some gypsy boys whom he had played with in his youth had shown him a bottle which they said contained a poison prepared from mouldy hay capable of producing sickness of a lingering, wasting character, terminating in death—like consumption in general character. Immediately the idea occurred to me that we *may* find in this direction the true nature and mode of action and dissemination of tubercle in the human family. The extent of its association with the "bacillus tuberculosis" has led most observers to consider the latter as standing in causal relation to the disease Now this is a microscopic fungus and it therefore seems to me there is no *a priori* improbability of its existence in musty hay and fodder and when we consider the condition of food given to much of the live stock by improvident and unthrifty farmers a ready explanation of the spread of the disease now so generally dreaded is at hand In speaking on the subject with Dr Samuel G Dixon the distinguished bacteriologist I found him fully alive to the possibilities of fruitful results from investigations into the transplantation of fungoid and actino mycoid growths from a vegetable basis to animals and that some German authorities have already done good work in this direction Observations tending to establish an identity between the bacillus tuberculosis and other fungoid growths could not fail of being most important aids to us in combating the dread disease which sweeps away such a large portion of the human race Nor should we forget that during the late war of the Rebellion a very fatal epidemic of spotted fever black measles or cerebro spinal meningitis as it was called broke out among soldiers who were supplied with mouldy hay which was used for bedding The epidemic spread by contagion quite extensively

I have also been informed that the disease among horses known as cerebro spinal meningitis is clearly traceable to mouldy hay among the Dutch farmers near Lancaster It is called putrid sorethroat because the mucous membrane of the throat becomes inflamed and gangrenous and the bolus of food is not swallowed owing to paralysis of the muscles of deglutition We have thus as it were a connecting link with the phenomena of diphtheria which is also traced to a mould or fungus which may grow upon any abraded moist or mucous surface The tendency of pathological investigations and studies during the past twenty years has been more and more towards the discovery of intimate causal relations between many diseases not formerly recognised as zymotic and corresponding fungi or bacteria or bacilli We forget too often that these are only terms for microscopic fungi or moulds that the same laws of propagation and growth govern them as their larger congeners that the very term ' zymotic so long used in medical literature shows that our predecessors properly classed them as the results of ferments and thus are liable to be led away from true methods of checking their ravages Undoubtedly these are to be sought by better acquaintance with their life conditions and a large step in advance will have been made if we should be able to trace them from their ordinary and comparatively innocuous vegetable *habitats* to their dangerous migrations to animals I do not know that in this connection attention has been drawn to the typhus fever epidemics which have followed extensive vegetable disease, *e g*, the Irish potato rot or the effect of ergotized rye and wheat on the poorer classes in Italy and the Balkan provinces To return to the subject of tuberculosis in animals, including man the conditions for its virulent spread are eminently those favoring fungous growths—deficient vital force (whether original or acquired from overstrain), damp dwellings, overheated vitiated air and insufficient food Add to these the germ and the result is not long in showing itself Take these away and the germ is harmless comparatively A good illustration of this is to be found in the animals especially the monkeys crowded together in our zoological gardens What better field could be found for a properly conducted series of experiments on the thorough disinfection of air and food Isolation of infected individuals and curative agents? The latter should embrace such bactericides as can enter the circulation harmlessly and such natural food as will sustain the animals The late Dr Shippen's experience with the lessening of tuberculous and scrofulous disease among the colored inmates of the House of Refuge after the introduction of corn meal as a large part of their diet should not be lost sight of Might not a diet of cocoanuts and palmnuts be useful to our monkeys?

In conclusion I would urge upon our microscopists the study of the whole class of moulds and fungi both in their usual forms and as to their transplanted forms in animal media and in living animals

Pending nominations Nos 1273 and 1274 were read

On motion, it was

Resolved That Rev Robert W Rogers Ph D be appointed a delegate to represent the Society at the Congrès Internationale des Orientalistes to be held at Geneva in September 1894 providing that the same shall entail no expense whatever upon the Society

And the Society was adjourned by the President

Stated Meeting, March 16, 1894

Dr J Cheston Morris in the Chair.

Correspondence was submitted as follows

A letter accepting membership from Sir Henry Bessemer, London, Eng

An invitation from the Maryland Historical Society, Baltimore, to attend its Fiftieth Anniversary, March 12, 1894

Letters of envoy were received from the Geological Survey of India, Calcutta , Société des Naturalistes, Moscow, Russia , K Sachsische Gesellschaft der Wissenschaften, Leipzig , Société d'Histoire Naturelle, Strassburg, Alsace.

Letters of acknowledgment were received from the K K Sternwarte, Prague, Bohemia (141), Société d Histoire Naturelle, Strassburg (140 141), Prof Abel Hovelacque, Paris, France (141) Dr Traill Green, Easton, Pa (142), Prof John F Carll, Pleasantville, Pa (142), Mr Jedediah Hotchkiss, Staunton, Va (142) Scientific Society, Denver, Colo (142), Central Meteorological Observatory, Mexico, Mexico (140, 141), Observatorio Astronómico Nacional Mexicano, Tacubaya (142), Instituto fisico geografico Nacional, San José de Costa Rica, C A (141), Museo Nacional, Buenos Aires, S A (139, 140, 141)

Accessions to the Library were reported from the Geological Survey of India, Calcutta, Statistica Central Byran, Stockholm Sweden K K Zoologisch botanische Gesellschaft, Prof Karl Penka, Vienna, Austria, Gesellschaft für Erdkunde, Berlin, Prussia, Naturforschende Gesellschaft, Freiburg i B, Société d'Histoire Naturelle, Strassburg, Alsace, Naturforschende Gesellschaft, Zurich, Switzerland, "Il Nuovo Cimento," Pisa, Tuscany Université de Lyon, France, Instituto y Observatorio de Marina, San Fernando, Spain, R Meteorological Society, London, Eng, Royal Society, Edinburgh, Scotland, Theological Seminary, Andover, Mass, Commission of Public Records, Boston, Mass, Mr Walter S Logan, New York, N Y, Hon Robert E Pattison, Harrisburg, Pa, Dr C S Dolley, Philadelphia, California Academy of Sciences, San Francisco, Historical Society, Chicago, Ill, Experiment Stations, Raleigh, N C, Ames, Ia, Lincoln, Neb, Corvallis, Oreg

The death of Cavaliere Damiano Muoni, Milan, Italy, February 22, 1894, æt 74, was announced *

* Cavaliere Damiano Muoni was born at Antignate Province of Bergamo Italy on the fourteenth day of August, 1820 His early life was studious, and his ambitions patriotic He participated in the ill-starred insurrection le cinque giornate of 1848 at Milan and in consequence was obliged to be absent from his country for a long period His time was filled with study and he returned the possessor of much valuable historical and archæological matter His activity in authorship was unceasing and over one hundred books, pamphlets papers etc attest his proficiency in history genealogy archæology fine arts and other branches of knowledge He held the position of State Archivist for many years and was zealous courteous and obliging

Mr. Henry C. Baird read a paper entitled "Association: The Dominating Need of Man, and the Keystone of Social Science."

After which a desultory discussion on the subject of the paper took place.

Pending nominations Nos 1273 and 1274, and new nominations Nos. 1276 to 1296 inclusive were read.

And the Society was adjourned by the presiding member

PROCEEDINGS

OF THE

AMERICAN PHILOSOPHICAL SOCIETY

HELD AT PHILADELPHIA FOR PROMOTING USEFUL KNOWLEDGE.

VOL. XXXIII JUNE, 1894 No. 145

Stated Meeting, April 6, 1894.

Vice-President KENDALL in the Chair.

Minutes of last meeting read.

Correspondence was submitted as follows:

Letter accepting membership from Dr. Isaac Roberts, Starfield, Crowborough, Sussex, England.

Circular letter from the Directeur of the Direction Générale de Statistique, of the Province of Buenos Ayres, announcing his appointment to that office.

Accessions to the Library were reported from Mr. Edward Counsel, Melbourne, Australia; Mr. N. A. Cobb, Sydney, Australia; Bataafsch Genootschap, Rotterdam, Netherlands, K. K. Naturhistorische Hofmuseum, Vienna, Austria; Gesellschaft fur Erdkunde, Deutsche Seewarte, Berlin, Prussia; K. Gesellschaft der Wissenschaften, Göttingen, Prussia; Würtembergische Kommission für Landesgeschichte, Stuttgart; R. Istituto Lombardo, Milan, Italy; Società Italiana delle Scienze, Naples, Italy; R. Accademia delle Scienze, Turin, Italy; Académie des Sciences, etc., Angers, France; Académie N. des Sciences, etc., Caen, France; Société des Sciences Naturelles et Archéologiques de la Creuse, Guéret, France; Dr. P. Topinard, Paris, France; Société des Antiquaires de la Morinie, Saint-Omer, France; Historical Society, Dr. Hugh

Hamilton, New York, N. Y.; University of Pennsylvania, Dr William F. Norris, Philadelphia; U. S. Naval Institute, Annapolis, Md., Smithsonian Institution, Bureau of Education, U. S. Coast and Geodetic Survey, Washington, D. C.; Director of the Michigan Mining School, Lansing; Dr. Jesus Diaz de Leon, Aguascalientes, Mexico.

The following deaths were announced:

Dr. E. Brown-Sequard (Paris, France), born 1818, died April 2, 1894.

Sir P. Cunliffe Owen (London, Eng), born June 8, 1828, died March 23, 1894.

Hon. Washington Townsend (West Chester, Pa.), died March 18, 1894, æt. 82.

Obituary notice of Thomas M. Cleemann was read by Mr. Prime.

Prof. Cope made a communication on some points of the anatomy of the Ophidia, especially regarding the lungs.

Mr. Lyman offered for the Proceedings a map of the New Red, New Jersey.

Pending nominations Nos. 1273 and 1274, 1276 to 1296, and new nominations Nos. 1297 and 1298 were read.

And the Society was adjourned by the Chairman.

Stated Meeting, April 20, 1894.

Vice-President, Mr. **Kendall** in the Chair.

Minutes of meeting, April 6, read.

Correspondence was submitted as follows:

Letters of envoy were received from the K. Meteorologische Institut, Berlin, Prussia; Editors of *Nuovo Cimento*, Pisa, Italy; Musée Guimet, Ministere des Travaux Publics, Paris, France; U. S. Coast and Geodetic Survey, Washington, D. C.

Letters of acknowledgment were received from the Bibliothèque de l'Université Royale Lund, Sweden (140, 141) K. D. Videnskabernes Selskab, Copenhagen Denmark (Trans. xvii, 3, xviii, 1, Proc., 141), K. Zoologisch Genootschap "Natura Artis Magistra," Amsterdam, Netherlands (142) K. Zoologisch Botanische Genootschap 's Gravenhage, Netherlands (142), Koloniaal Museum, Fondation de P. Teyler van der Hulst, Haarlem Netherlands (142), Prof. G. Tschermak, Vienna, Austria (140, 141), K. Gesellschaft der Wissenschaften, Gottingen, Prussia (141), Observatorio Astronomico della R. Università, Turin, Italy (141), Société d'Anthropologie, Paris, France (140, 141) U. S. Naval Observatory, Washington, D. C. (142), Society of Natural History, Cincinnati, O. (142), Historical Society of Southern California, Los Angeles (96–142, and Catalogue, Parts i–iv) Kansas State Historical Society, Topeka (142), Observatoire Météorologique Central de Mexico, Mexico (140–142, and Catalogue, Parts i–iii) Bishop Crescenzio Carrello Ancora, Mirida, Yucatan, Mexico (142)

Accessions to the Library were reported from the Exhibition Trustees, Melbourne, Australia, Lund University, Lund, Sweden, Academie R. des Sciences, etc., Copenhagen Denmark, Akademie der Wissenschaften, Physikalische Gesellschaft, Berlin, Prussia, Bath and West of England, etc., Society, Bath, Eng., Philosophical Society, Cambridge, Eng., Society of Antiquaries, London, Eng., Amer. Academy of Arts and Sciences, Massachusetts Historical Society, Dr. Samuel A. Green, Boston, Mass., Public Library, Salem, Mass., Tufts College, Mass., Academy of Sciences, New York, N. Y., Dr. D. Jayne & Son, Philadelphia, Enoch Pratt Free Library, Baltimore, Md., Elisha Mitchell Scientific Society, Chapel Hill, N. C., Society of Natural History, Cincinnati, O., Mr. S. Waterhouse, St. Louis, Mo., Agricultural Experiment Stations, Orono, Me., Burlington, Vt., Amherst, Mass., Storrs, Conn., Blacksburg, Va., Columbia, Mo.

Announcement of death:

Dr. William V. Keating, Philadelphia, April 18, 1894, æt. 71

On motion, the President was authorized to appoint a suitable person to prepare the usual obituary notice

Mr Price offered the following

Resolved That a Committee of three members of the Society be appointed to confer with the representatives of other societies and organizations with reference to a public dinner which it has been proposed to give the Hon Frederick Fraley the President of this Society on the 28th day of May the ninetieth anniversary of his birth

The following Committee was appointed Messrs Price, Vaux and Dr Brinton

Mr Bache read an article explanatory of the Brownian movements Dr Brinton made some remarks on the subject

Pending nominations 1273 1274, 1276 to 1298, and new nominations 1299 and 1300 were read

Mr Prime offered the following resolution, which was seconded by Dr Brinton

Resolved That a Committee of five members be appointed by the President to take into consideration the state of the Society and to report whether any and if any what measures it may be expedient to take for increasing the resident membership of the Society and promoting its usefulness and whether in effectuating these purposes it may be necessary to amend the existing laws and regulations

The matter was discussed by Messrs Prime, Brinton, Price, Horn and Lyman

On motion, the resolution was adopted

The President subsequently appointed the following Committee

Frederick Prime, *Chairman*, J Sergeant Price, George H Horn, William P Tatham, J G Rosengarten

And the Society was adjourned.

The Secret of the Brownian Movements.

By R. Meade Bache.

(Read before the American Philosophical Society, April 20, 1894.)

We first hear systematically of molecular movement, as a thing directly visible, from the writings of the distinguished botanist Dr. Robert Brown, embodied in a paper entitled "A Brief Account of Microscopical Observations, Made in the Months of June, July and August, 1827, On the Particles Contained in the Pollen of Plants; and On the General Existence of Active Molecules in Organic and Inorganic Bodies."

Of course we know inferentially, through physics and chemistry, that the particles of bodies move under the influence of various extraneous forces, and we know, too, that, in the case of matter in a gaseous form, they move also under the influence of force inherent in their own constitution. But the movements of which I am about to speak relate to the visible behavior of what should be termed inert matter, if that expression were not begging the question of whether or not it has in itself power of motion, and thus deciding it in favor of the view that it has not, but is moved by extraneous force. We must begin, therefore, as is but right, by assuming that it is an open question as to whether or not certain particles, in aqueous suspension, call them molecules or otherwise, as one pleases, organic or inorganic, but not endowed with animal life, are of themselves capable of movement, or are moved by some extraneous force or forces at present unknown. The solid ground of fact from which we start is that, under the conditions mentioned, they do move, for that is undeniable and admitted.

Dr. Brown soon discarded, through disproving in the course of his investigations the surmise which he had made, that the particles of pollen indicated by their motion a mode of function analogous to that of spermatozoids, and rested eventually in the conclusion that particles moving in aqueous solutions are not confined to organic bodies or to their products. He had conducted a series of experiments on finely crushed glass, on simple earths and metals, with many of their combinations, and rocks of all ages, including those in which no organic remains have ever been found. Moving particles presented themselves in each of the constituent minerals of granite Even a crushed fragment of the Sphynx gave the same results He tried substances of both aqueous and igneous origin, travertine, stalactites, lava, obsidian, volcanic ashes, meteoric matter, manganese, nickel plumbago bismuth, antimony, arsenic asbestos, actinolite tremolite, zeolite, and steatite He tried particles of wood, living and dead linen, paper, cotton, silk, wool hair, and muscular fibre that had been exposed to fire under the blowpipe douched with water and submitted to immediate examination The particles from all these substances exhibited as vivid movement after as before they had been so treated

Dr Brown about twelve months later, went on further to declare, under the head of ' Additional Remarks on Active Molecules, ' that — The result of the inquiry at present essentially agrees with that which may be collected from my printed account, and may be here briefly stated in the following terms, namely, that extremely minute particles of solid matter, whether obtained from organic or inorganic substances, when suspended in pure water, or in some other aqueous fluids, exhibit motions for which I am unable to account, and which from their irregularity and seeming independence, resemble in a remarkable degree the less rapid motions of some of the simplest animalcules of infusions That the smallest moving particles observed, and which I have termed Active Molecules, appear to be spherical, or nearly so, and to be between 1 20 000 and 1 30 000 of an inch in diameter, and that other particles of considerably greater and various size, and either of similar or of very different figure, also present analogous motions in like circumstances I have formerly stated my belief that these motions of the particles neither arose from currents in the fluid containing them, nor depended on the intestine motion which may be supposed to accompany its evaporation These causes of motion, however, either singly or combined with others,—as, the attractions and repulsions among the particles themselves, their unstable equilibrium in the fluid in which they are suspended, their hygrometrical or capillary action, and in some cases the disengagement of volatile matter, or of minute air bubbles,—have been considered by several writers as sufficiently accounting for the appearance Some of the alleged causes here stated, with others which I have considered it unnecessary to mention, are not likely to be overlooked or to deceive observers of any experience in microscopical research, and the insufficiency of the most important of those enumerated, may, I think, be satisfactorily shown by means of a very simple experiment" [Dr Brown here alludes to what he details at considerable length, as *to the trituration together of oil and water so as to* secure in one case, by a large proportion of water to oil lacunæ of water of various sizes, filled with particles, protected from evaporation by the oil, and in the converse case, by a small proportion of oil to water, to secure minute oil drops on the surface of the water, some of which drops were not larger than the solid particles in the water]

These passages from the writings on this subject of so skillful careful, and conscientious an observer as Dr Brown was excite regret that he had not pursued the subject further He would have found, among other things, a much simpler and more lasting method of excluding air from the drop under observation than that which he adopted in forming lacunæ of aqueous fluid protected from evaporation by immersion in oil He would in all probability have discovered the real cause of the motion of organic and inorganic particles in aqueous fluids But he dropped the subject, perhaps because he was obliged so to do on account of the pressure of other research when he had obtained some valuable results, leaving his *investigations negative as to conclusions* He doubtless began with the supposition, which seems common at first to all investigators of the subject, that evaporation might represent a shock that would move the particles suspended in water, that vibration from mechanical sources might account for the movements, that currents set up in the drop of water by differences of temperature in it or slight differences in the temperature of the air surrounding it, might account for them, or that mutual attractions, derived from gravitation, and inherent in the relative density of the particles themselves, might do so and he found, as every one else will find who experiments in these directions, that the movements go on independently of currents and independently of heat, generating or not generating currents, independently of light, and in the case where the particles represent an extremely fine division of matter, and are at the same time of low specific gravity, even independently of terrestrial gravitation, and without relation to their specific gravity, with the force of their mutual gravitation entirely masked.

Some of these things Dr Brown implies that he saw in the course of his investigations, others he could hardly have failed incidentally to see, but one that I have mentioned, he did not rightly interpret. It was a distinct lapse in his acuteness of observation, that involved in his mention, without perception of its deepest significance, of minute drops of oil, some of them not exceeding the solid particles themselves in size, standing nearly or altogether at rest on the surface of water; the pointing of which fact is very clear: one which, had it been known to me, would have induced me to try oil as well as water among the first instead of among the last of my own experiments, as actually happened in their sequence.

To afford facility for the fullest comprehension of the subject it becomes proper here to resume the historical tenor of our way with a brief account of some of the views of Herren Wiener, Exner, and Schultze, more recent than those of Dr. Brown. In order to avoid the responsibility for the necessary condensation, I prefer to quote as follows, from the summary of their views in the *Jahresbericht* of 1867.

"Then Chr. Wiener, from whose account the preceding historical remarks are quoted, instituted microscopic observations of these movements, and came to the conclusion that this trembling, irregular, unsteady motion of solid molecules which alter their direction in the briefest fraction of time in their zigzag course, has for its basis the continual movements which, by virtue of their molecular constitution, belong to fluids. He learned through his investigations (1) that the movements are not those of infusoria; (2) that the movement is not communicated to the fluid; (3) that the trembling movement is not in any way derived from the varying attraction and collision of the various oscillating molecules with one another; (4) that the movement is not derived from changes of temperature; (5) that, also, the movement is not derived from evaporation. Consequently, there remained to him nothing to ascribe as the cause of the peculiar movements but the property of the fluid itself. This explanation received direct confirmation from Wiener's observation, that the amount of the movement has a certain relation to the size of the molecule. Lately S. Exner has extended the investigations of Wiener. Among the various influences which Exner sought to test with reference to the molecular motion was whether either chemical causes or mechanical ones, such as pressure, vibration, and so forth, could in any way produce an acceleration or a retardation of the effect. Only by exposure to light and heat did the motion become accelerated, and then in such a manner as, in the case of glycerin, the molecules of which under ordinary conditions show scarcely any, if any movement at all to exhibit it clearly when warmed up to fifty degrees centigrade of temperature. Exner also examined into the properties of fluids in which solid molecules remain suspended. The results of his investigation resolve themselves into the following points: (1) The liveliness of the molecular movement is heightened by light and heat, and by radiant as well as by conducted heat; (2) one of the consequences of the molecular movement is that the molecules, in a specifically lighter fluid, not only do not sink to the bottom, but overcome the force of gravitation to such a degree as to spread themselves equally throughout the fluid; (3) the velocity of this scattering is as the intensity of the molecular movements influenced by light and heat. It should be mentioned here that Dr. Schultze had already stated that substances when most finely divided, especially such as seemed under the microscope to be amorphous and exhibited the brownian movements, remain suspended in pure water and in many other fluids for days, weeks and months at a time, so that the fluid containing them presents a cloudy, or at least an opalescent appearance."

The account of the views of Herr Wiener in the *Jahresbericht'* makes an important omission. It devotes itself chiefly to reciting what, in his view, does not cause the brownian movements, but does not mention precisely to what he does ascribe them. Herr Wiener says, in the last paragraph of his article in *Poggendorff's Annalen*, 1863:—"The weight of the preceding conclusion, that one cannot ascribe the trembling movement to any exterior cause, is very greatly added to by the ascertained fact, that the diameter of the similarly moved water masses is so small that it nearly corresponds with the wave length of red light, and still more closely with that of radiant heat." This passage gives the keynote to his views on the brownian movements. After a most elaborate series of experiments, in which he measured on a micrometrically divided glass slide, with the addition of diagonal lines, and by watch, the range and the time of the movements, he reached his most important conclusion, that, because the dimensions of the aforesaid wave lengths of light and heat have a certain close correspondence with the diameters of the minutest particles and water masses, they form the moving impulse of the motions of the particles. He pictured to himself that the æther surrounding the particles, being continu ous with the æther of space acts through the rays of light and heat on the particles and minute water masses generating in their interaction as the visible resultant of the forces in play the movement of the particles in suspension in aqueous solutions But if the cause of the movements assigned by Herr Wiener were the true one the same cause ought to be operative in the case of alcohol and in that of the fixed and volatile oils but it is not This conclusion of Herr Wiener's seems to me to be derived from the unsatisfactory fact of a coincidence of which kind of proof we habitually perceive more than enough to obscure bewilder and often to baffle our feeble efforts to penetrate beyond the veil of phenomena of things as they seem to the everlasting noumena, things as they are near the inscrutable throne of nature

I will not weary my hearers with the recital of the numerous details of my own experiments, the names of the substances that I tried the modes in which they were treated the manipulations of various sorts necessary to the prosecution of the work Every one knows the difficulties that will arise in new investigations which will themselves suggest the means of countervailing them as the work proceeds In this particular case one difficulty was to obtain finely enough divided matter in other liquids besides water It may be interesting to mention that I did not read anything on the subject until my own experiments were nearly finished By this course I avoided any possible bias expressed or implied in the directions to be pursued and the conclusions to be drawn, and I had ultimately the satisfaction to perceive, as I had often before observed, how owing to the constitution of the mind, men necessarily follow the same general and often particular track in their procedures It is not in the course they follow, that they differ much, but in the conclusions which they reach in pursuing what is virtually the same way Fortunately for me, constrained to be absent for months in the field on geodetic duty, and at all times constantly engaged at my profession, night still lent itself to my slowly accumulated results That the investigation was most interesting, I need hardly say

As electric currents have been demonstrated in the human body, I naturally thought that all slight differences of tension between the liquid and particles, or in the liquid itself, might set up electric currents Therefore I passed the galvanic current through liquids filled with particles, watching them carefully There was not the slightest visible effect thereby produced on the movements of the particles. If the movements had been produced by electric currents then so strong a current as I often passed through a drop of water ought to have left no manifestation of movement possible from the necessarily weak, if actually existing, currents supposed to be actuating the particles. The molecular movement, so called, is, as described by Herr Wiener, a zigzag one, but that term does not exactly convey the peculiarity of the motion. It is a combination of a jerky, wobbling movement performed within determinate bounds entirely irrespective of the sweep of currents in the liquid, or even of the effects in some cases of terrestrial gravity and in no case seemingly affected by the influence of local gravitation of particle to particle. Taking the vermilion of the sulphide of mercury, as finely divided as it can be made, and turning the microscope at even a slight angle from the vertical, the effect of terrestrial gravity on the particles becomes at once apparent but taking the carmine, reputedly made of cochineal the particles are not affected in the slightest degree by terrestrial gravity. Of course it is hardly necessary to say that any solution should be weak in order to allow the substances under examination to receive the finest division of which each is susceptible as dissolved. The specific gravity of sulphide of mercury is not only much greater than that of cochineal, but additionally it is not susceptible of nearly so minute division as cochineal is. Of all substances that I experimented with, cochineal seemed to be that which is capable of the finest division, and at the same time of the most brilliant illumination. Gamboge, which appears to be the substance of predilection among many persons to experiment with for the brownian movements, offers nothing comparable to the brilliancy and the fineness of particles of carmine derived from cochineal. With a weak aqueous solution of carmine one may see by daylight, on a background of faint blue, and by ordinary artificial light, on a golden one, thousands of tiny particles, bright as sparks of ruby, shimmering and performing their independent evolutions over the field of view.

Just as one sees a boat managed by an unskillful helmsman pursue its erratic way in going about, being taken aback, or heeled over by a flaw of wind, without for a moment attributing its movements to currents or any other cause but the true one, so the constant observer of the brownian movements knows full well that the particles themselves are moving, not being moved by currents or by gravitation towards the earth or among themselves He, from the first recognizes the fact that the smaller the particles are, the more vivid is their movement He recognizes another, that, although many large particles do not, as masses, move at all yet the larger masses are all alive, as it were, with smaller ones, seen clearly around their periphery, on the silhouette of which they are seen plying like banks of oars in an ancient trireme He is struck with and convinced of still another thing, that whereas one might expect to find that all particles would manifest an attraction for each other through gravitation and that the larger and largest, but all in proportion to their relative size, would attract and absorb the relatively smaller and smallest ones, nothing of the kind occurs but the smaller, down to the smallest go their own way, sometimes even touching the largest and bounding off and away as if they do not, as indeed they do not visibly, submit to the force of gravitation Of course they cannot escape the influence of gravitation, whether terrestrial or among themselves but the effect of gravitation upon them is masked, in what manner will appear later

It seemed to me that magnetic earth waves might affect particles in such delicate suspension as those of which we are speaking some of which are no greater in diameter than 1 100,000 of an inch, seen under various powers capable of magnifying from 650 to 1300 diameters Accordingly, I have placed the particular fluid under examination in the lines of force of a permanent magnet, with the magnet on one side and the keeper on the other of the drop of fluid Concentrating the gaze on individual particles, to observe if their movement were modified and then on others in succession, and often repeating the experiment, nothing could be observed other than the movements existing before the magnet had been brought into requisition The only kind of particles susceptible to the influence of the magnet were those of precipitated iron, but iron is always obedient to the magnet

Heat I applied in various ways, either irregularly or in an endeavor to distribute it as equably as possible on the glass slide on which the particular experiment was made Mere currents are set up during the adjustment of temperature from radiation At the same time one can observe and differentiate the motions due to the brownian movements, the motions along currents, and also the motions from terrestrial gravity, if any, exhibited by particles, if the specific gravity of the substance be great and the microscope be set at an angle with the vertical.

Cold I also applied, putting the slides with their cover glasses in a freezing mixture of broken ice and water and reducing them to a very low temperature. Still the movements went on as apparently unmodified as ever. Herr Exner says, it will be remembered, that glycerin, which under ordinary conditions shows absolutely none or almost no molecular movement, shows it clearly when warmed up to the temperature of fifty degrees centigrade. In all the finely divided bodies, however, which I examined, there seemed to be no increase or diminution in the intensity of the movements corresponding with their alternate subjection to heat and cold. There were occasions in which I thought that I observed acceleration from light, but I always ended by imputing it to the force of imagination, and if it were not justly ascribable to that cause, the fact that it could be so ascribed, is proof positive that if, through the influence of light and heat, any intensification of the movements of the particles took place, it must have been very small. Moreover the evidence is certainly here, to show that even if the movement were intensified by light or heat, that was the only influence that could be ascribed to them, that light and heat could not be deemed the cause of the movement. And lastly, Herr Wiener's micrometric measurements of the range of movement at different temperatures completely bore out this conclusion.

The theory of Herr Wiener, that the movements are due to the action of the red wave of light and heat is refuted by the single fact that, as I have proved by experiment, one may interpose at pleasure between the source of light or heat and the particles, either a violet glass or a red glass, without being able to observe the slightest alteration in the movements, either as to their range or their velocity. That is to say, red rays may be either partially excluded or selectively admitted, without diminishing or increasing the liveliness of movement. Hence light can have nothing to do with the phenomenon under discussion, and I have just shown, through the citation of the freezing mixture experiment, that heat can have nothing to do with it.

I have reserved to the very last the discussion of the question as to whether or not the shock, if any there be, from evaporation can have anything to do with the movements, although this was a point that entered into my first investigations. I have reserved it to the last, because its discussion requires more than the brief space which I have devoted to the previous individual results, and because it leads directly to the conclusion that I have finally reached as to the true cause of the movements. I started out with the conception, which it seems is common to every one, that evaporation might be accompanied with a series of minute explosions, which produce shocks that manifest themselves through the mass of an aqueous solution, in the form of minute movements of finely divided matter held in unstable equilibrium by suspension in the fluid, and that these, escaping cognizance from any ordinary observation, might be visible as such, or in their effects, through the instrumentality of high powers of the microscope. I had come to believe long before, from observation and experiment, that no tremors from mechanical agency or any other, except perhaps from evaporation, could produce the peculiar movements known as brownian, and finally it remained to discover if this or any other intrinsic cause were at work that would account for them.

At this point I encountered an obstacle. My high powers of the microscope were both water-immersion lenses. It seemed, therefore, that even when I had had the drop of liquid under observation, sealed beneath a cover-glass, I might have included, by the use of the water-immersion lens itself, an evaporating surface which might have produced the optical illusion of the movement of the particles in suspension. I proceeded, however, with my experiments, upon the assumption that this, as the event proved to be the case, was not true, and meanwhile procured from Vienna a one-fifteenth dry-lens by Reichert, the highest power of dry-lens that he makes.

I had already obtained for high-power lenses a film of liquid thin enough to be observed through all its strata, free of air within the cell, and protected from evaporation by being hermetically sealed. Any ordinary manufactured cell is too deep, and with all precautions taken contains a little air. On the other hand, the mere cover-glass superposed on a glass slide contains too slight a depth of fluid. I made a cell by using gum-shellac traced in a circlet on a glass slide, which cell, when partially dried, is filled to the brim with the liquid to be observed upon, whereupon the cover-glass is pressed into the yielding gum, thereby expressing the contained air with the superfluous liquid, when the product, dried over night, is fit for use on the following evening. One slide, prepared in this manner and filled with a slightly tinted solution of carmine from cochineal, had been observed upon by me for weeks, with a one tenth water immersion lens, and afterwards, upon the arrival of the one fifteenth dry lens was observed upon without showing any variation in the range and vividness of movement of the particles subjected to examination. I have even covered the whole microscope with a pall of thick, black, woolen cloth, so that not a ray of light could enter it, either through the cover glass or the eye piece and then carefully placing the eye close to the eye piece have suddenly thrown light upon the cover glass when the brownian movement among the particles was perceived in as active play as ever. I have therefore concluded, from all these experiments, that neither heat nor light nor electricity, nor magnetism, nor mechanical shock, nor finally evaporation, is operative in producing the movements, in a word, that the particles move uninfluenced by these forces. I am therefore constrained to believe, upon the basis of the information that I have obtained in the manner described, that it is not the particles which are moved by their own energy, or moved by any energy directly imparted to them from outside sources, but that it is the fluid that moves them.

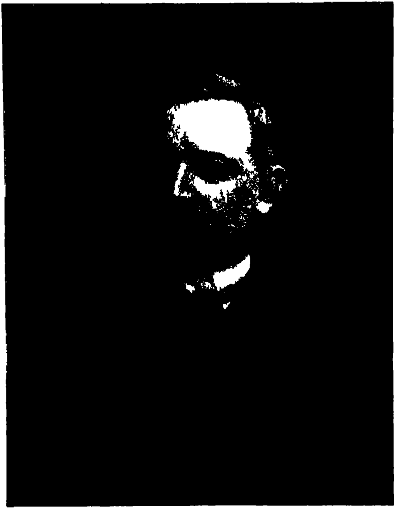
If their own energy moves the particles, we should see them at the same time obedient also to the law of gravitation among themselves, manifested as the resultant of whatever forces are in play, whereas, although they must be obedient to the law of gravitation among themselves, its effects, and generally, as well, those of terrestrial gravity, are so masked as not to be at all perceptible. Now, when we consider how minute all of these particles are and yet that they move apparently unhindered with such constancy and force, it ought to be apparent, I should think, that they have no self motive power. However erratic the paths of individual particles may be, the likeness among the movements is extraordinary, so almost identical in every case, varying in greatness of range and rapidity only in inverse ratio to the size of the particle, that we can not conceive of self actuated particles so behaving, for relative greatness of size in self actuated particles ought to coincide with relatively greater, not relatively less, energy of movement, whereas, here the case is reversed. But there are other facts that I have observed through experiment, which also prove what I say. In alcohol, and as far as my experiments go, in fixed and volatile oils, the brownian movements are not observable, and yet the microscope plainly reveals that the movements of foreign bodies in all these is as free as in aqueous solutions, and I think more so So molecular movements of solid particles in suspension in aqueous fluids must take place perforce of the constant repulsions of the constituent molecules of the particular liquid present—water The minute drops of oils supernatant on water, some of them no larger than the particles in the water below, observed by Dr Brown, as he says, to be almost or wholly motionless, so behave because the molecules of water glide by the molecules of a substance for which they have not even the affinity that would compass opposition Be the globules of oil on water never so small or large, the molecules of the aqueous fluid glide by them Whether a small or a large globule of oil be the particle itself on water, there is no movement of the particle Dr Brown says none, or almost none I think that he was mistaken, that there is no molecular movement whatever

Fixed oils have not the same molecular constitution as volatile oils, nor these the same as alcohol, nor either the same as water Whatever these differences may signify in various behaviors, under varying conditions, one, among the rest, distinguishes water from the rest and all other liquids Despite its apparent perfect fluidity, the reluctance of its molecules to move among themselves as smoothly as do those of other liquids among themselves is one of its most evident characteristics We see this exemplified by the way, long since ably demonstrated, in which a wave is built up from ripples, by the way in which the surf breaks along the shore, and in the ease with which a small proportion of oil in contact with water modifies or subdues its energy Only recently I steered a boat in Boston harbor between two headlands, between which, and far beyond, white caps covered the surface of the water, surrounding a placid lakelet of a square mile in area, black by contrast to its white capped margin, over the surface of which lakelet I was soon smoothly gliding, and this change from turbulent to placid waters was wholly due to the merest film of oil from Boston s great sewer discharging its contents three miles away on the lowering tide from the head house on Moon Island into the current running towards the sea I am aware, of course, that part of the calmness described was owing to the fact that the oil lessened the friction of the wind on the water But that was not the only cause of the calming effect produced by the oil Oil prevents the friction of parts on the surface of water already in agitation, and thereby quiets the wave already risen The area which I have just described as a smooth lakelet had been only a short time before my arrival at the place in precisely the same state of agitation as the surrounding waters. The surface is the part where the wave begins to form and where it receives constant increments, the wind propagating these and by impact on the growing wave or billow as a whole forming and propelling it as a mass, despite its tendency in deep water to oscillate freely in the vertical without translation horizontally. It is easily conceivable that, although particles of oil may, as I have stated, experience no sensible friction when in contact with the molecular movements of water, so almost infinitesimal are they in range, yet that oil forming a film over a large surface of water may through friction, as an enclosing sheath, tend to quiet the water, and thus impair and gradually destroy its ability to continue the massed effect known as a wave, at the place, the surface where not only is it generated but where it most effectively tends to preserve its energy of movement.

Thus, it is not only through its weight that water, when set in active motion, becomes so formidable as we know it to be when in angry mood. It is because, besides the momentum with which it can be endowed through its great weight, it lends itself, through its molecular constitution, to the storage of enormous energy and to the yielding up of that energy reluctantly. Assuming the existence of a sea of oil or one of alcohol, and either in a state of turbulence, and moreover eliminating in imagination the difference in weight between these and water, either in comparison with water equally turbulent would gently come to rest.

The difference between Herr Wiener's view and mine is radical. He speaks of the motion common to fluids as the cause of the brownian movements. But such motion, at least as perceptible through the microscope, does not exist, except in water or in some other liquid in which water is, as I have proved by experiment, a considerable constituent. Then Herr Wiener, although accounting for the brownian movements by hypothetical movements common to all fluids, really makes their causation the vibratory effect of rays of light and heat, to which, he thinks, fluids through their constitution lend themselves. I, on the contrary, show that the molecular motion, called brownian, taking place under all conditions imposable, is a property of water and of water only, and that light and heat have naught to do with producing it, although, as I have admitted, they may possibly act in intensifying it. All that I may claim to have detected is a phenomenon which reverts to the molecular constitution of water, as to which the moving, solid particles in it concerned in the brownian movement have no more to do than has a current-metre to do with the flow of the stream the swiftness of which it measures We do not deny that a gas may be essentially pure, and therefore homogeneous, a chemical as well as physical entity, and that, nevertheless, its molecules may have repulsions among themselves: on the contrary, we affirm it. Similarly water, recognized, as it is, as a chemical condition, not a mechanical mixture, has, as here demonstrated, repulsions among its molecules.

When I take into account all that I have detailed, and remember also that these moving particles of which we have been speaking, hermetically sealed under glass, as I have them now under cover-glasses, move indefinitely in time, unmodified in range and velocity, through changes of temperature, through light and darkness, through electricity and magnetism, in the presence of every force to which I have been able to subject them, I cannot but think, when I add that these movements are active in proportion to the fineness of subdivision of the particles, that they are caused by the mutual repulsions of the molecules of aqueous fluids. Did I see a relatively large mass moving as vigorously as the most minute one visible to the eye, I should regard this theory as untenable from that single fact alone, because it would be impossible that molecular action should concentrate effect on a relatively great mass; but when I see, as I do, the largest masses remaining unmoved, and descending in the scale, smaller ones, showing the effects of a faint impulse, and descending further still, others exhibiting sluggish movement, until the sight reaches the smallest particle visible, finding in that the most eccentric and vehement movement of any exhibited, I know then that I am looking at a sea where the little waves dash in vain on the impressionless rocks, barely disturb the floating ships and hulks, but twist and swirl and make frantically dance the little cockle-shells of boats wherever they may happen to be upon the surface; and that, in fine, I am witnessing the molecular movement of this sea in its effort to escape into space. The aqueous fluids, finding no release, as under my cover-glasses, the movements would go on forever; finding it in freedom from confinement, they go on until the fluid which is the condition of their manifestation is in a few minutes dissipated in evaporation.



Thomas Mutter Cleeman

I must confess that, although every conclusion reached through labor bestowed gives a certain pleasure in legitimate appetite for knowledge gratified, yet this is so far beneath what I had thought might lie hidden under the mystery of the brownian movements, I experience a sense of disappointment. I had thought that this investigation might be one of the paths that lead to the solution of the question whether or not energy is immanent in matter or a thing apart from it. For many years after the beginning of this century nothing fundamental in physics was known beyond the fact that matter is indestructible. It has been learned since, but no longer ago than about fifty years, that energy also is indestructible. It still remains perhaps to be shown that energy is but an emanation and manifestation of matter, reacting on it. Advanced as our knowledge is within a few years as to molecular movement, I had hoped that the investigation of the brownian movements might yield some contribution to molecular theory, and thence lead to a profounder knowledge than we now possess of molecular behavior in the abstract. I am able, however, to claim for the demonstration here no more than that the brownian movements are not the self movements of finely divided particles in suspension in aqueous solutions, which Herr Wiener had also ascertained, but simply that which he did not ascertain, movements generated by the molecular action of aqueous fluids, instead of being, as he and Herr Exner also thought, in differing form, phenomena due to light and heat. Perhaps even this moderate conclusion may be disputed, but it remains to be disproved.

Obituary Notice of Thomas Mutter Cleeman.

By Frederick Prime.

(Read before the American Philosophical Society, April 6, 1894.)

In the year just past, this Society has been called on to mourn the loss of more than the usual number of its resident members. Of these many were taken in the ripeness of their years with their life's work accomplished; some, however, were still in the full vigor of manhood, with apparently a long career still before them. To the latter class belonged the subject of this sketch.

Thomas Mutter Cleeman was born in Philadelphia, July 31, 1843. In his youth he attended the school of Mr Gregory in this city, where he formed many of the warm and close friendships which continued throughout his life. Entering the University of Pennsylvania in his sixteenth year, he graduated in the class of 1863, and whilst there developed that marked fondness for mathematical studies which clung to him through life. On leaving the University he entered, as a student, the Rensselaer Polytechnic Institute at Troy, N Y, graduating in 1863. His standing there was a high one, and on graduating he made an address at the Commencement.

His first active work was as Assistant Engineer on the Allegheny Valley Railroad and on the Pennsylvania Railroad, being under Mr. W H. Wilson, then Chief Engineer, and closely associated in the work of Mr. Joseph M. Wilson.

His intimate friend, Mr Walton W Evans, the eminent engineer, well-known for the high order of his work in South America, sent him to Peru in 1871, to supervise the erection of the first viaduct on the Verrugas Railroad. Being attacked with the Verrugas fever soon after his arrival, which lasted for several months, he was unable to work on the bridge. On his recovery he was appointed Division Engineer of the Callao, Lima and Oroya Railroad, where he remained for some years

On relinquishing his position in 1874 he returned to this country, but was again sent by Mr Evans to South America in 187d as Engineer of the Southern Railroad of Chile

In the interval between his two first visits to South America he was appointed Principal Assistant Engineer of the Main Building of the Centennial Exhibition in Philadelphia. Whilst filling this position he designed the ingenious construction of trusses, forming a central open space, clear of rods, at the junction of the nave and transept of that building

From 1876 to 1879 he was Assistant Engineer of the Philadelphia Water Department.

In 1880 he was appointed Resident Engineer of the Richmond and Allegheny Railroad in Virginia.

On relinquishing that position he engaged in a general engineering and consulting practice in Philadelphia.

In the winter of 1892–93 he went to Ecuador as Consulting Engineer on the water works at Guyaquil, at the request of his friend, Mr. A. Millet, who was the engineer and contractor. With this as with everything else he undertook, his interest in the success of the undertaking became very great and the exposure he underwent, in consequence, probably cost him his life. His work there was almost completed and he was looking forward to his return in a few days, so as to spend his Christmas with those he loved so tenderly, when he was stricken down with yellow fever. After an illness of about a week he died, on November 16, 1893, a stranger in a strange land far from those who now so deeply mourn his loss.

Mr. Cleeman was elected a member of this Society October 15, 1885.

He was also a member of the American Society of Civil Engineers of the Rensselaer Society of Engineers and of the Engineers Club of Philadelphia of which he was a Past President

In 1893 he delivered a course of lectures on railroads at the Rensselaer Polytechnic Institute in which he conducted the students through the actual surveys and calculations of the work

In 1880 he published a work on *Railroad Engineers Practice* which has gone through several editions

Mr Cleeman was a thoroughly experienced engineer cautious intelligent and original in his analysis of theoretical problems as well as in the execution of engineering work He was careful to first ascertain that any work he undertook was theoretically correct before carrying it out His grasp of theoretical subjects was so great that it enabled him to choose wise proximate methods A friendly critic he was also a keen one and his views were generally correct He did not hesitate to express his opinion on all subjects pertaining to his profession but never insisted on the acceptance of his view by others nor had he any of that selfish push and conceited manner which so often meets with undeserved success A refined cultured courtly gentleman he was entirely unselfish modest and retiring His first thought was always of others never of himself He was the light of a large circle of friends as well as of his family

His death has caused a heartfelt sorrow and sense of loss not only in the family circle where his sweet nature and gentle manners will always be missed but amongst the large number of warm and sincere friends who also loved and honored him

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The Dynamics of Boxing

By R Meade Bache

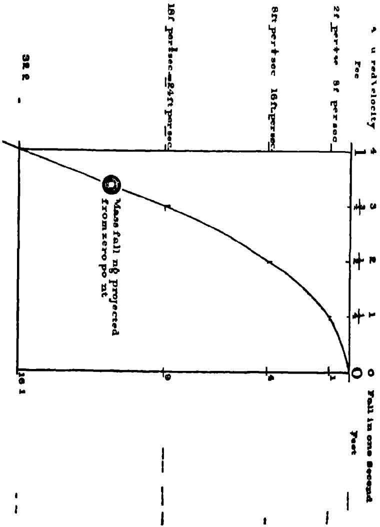
(Read before the American Philosophical Society, May 4, 1894)

The fact that a certain statement lately appearing in the daily press obtained circulation proves how great the general ignorance of some simple physical laws still is This statement was to the effect that Sandow, "the strong man," is able to strike a blow of 3000 pounds, could break an arm with its impact, and intends to study boxing so as to defeat Corbett A few observations, therefore, as to the fundamental laws connected with the subject of the possible degree of the deployment of muscular force by human beings in the act of striking a blow will not be out of place for popular instruction I do not, of course, presume to instruct members of this Society as to these laws, with which they are conversant, but the higher instruction is like head of water, whence the water flows to and filters through lower levels Besides, beyond the mere restatement here of the laws to which I refer, lies matter with which I think that not even the majority of the members of this Society are conversant These reasons form, in sum my explanation for introducing this particular subject to the Society

The momentum as you are aware, with which a body, falling freely near the surface of the earth, strikes, varies with the latitude, or otherwise expressed with the distance of a given place from the centre of the earth, which, owing to the configuration of the earth, corresponds with the latitude But, for general purposes, and quite sufficiently precise for this, the distance, in the first second, which a free body falls, near the surface of the earth, from a state of rest, is accepted as 16 1 feet, and the velocity which it has acquired by the end of that space and at the termination of that time, as twice 16 1 feet, or 32 2 feet in that second

The diagram on the blackboard illustrates clearly the effect upon a body moving for one second under the influence of gravity To understand, then, what follows, it will only be necessary to observe, by referring to the diagram, that the successive spaces traveled by the falling mass represent the squares of intervals, whether of space or time, and also that, although the maximum space traversed in a first second of fall is only 16 1 feet, yet that, correspondingly with the smaller spaces and the inclusive one (all squares of space or time), the acquired velocity doubles continuously, being, instead of 16 1 feet, 32 2 feet in the second, by the time that it has reached the end of the first second of fall The diagram fully exhibits the law of both relative spaces and relative times concerned in the phenomenon If the first unit of horizontal space on the diagram, one fourth, be taken as a unit of time, then its square will represent the value of the corresponding distance of fall This is 1 foot, with acquired velocity of 8 feet For successive units of time,—if a mass falls in 1 second, as it does, 16 1 feet, then in 2 seconds it falls 16 1 feet multiplied by 2 squared It falls in 3 seconds 16 1 feet multiplied by 3 squared, and in 4 seconds 16 1 feet multiplied by 4 squared, and so forth

Could a soap bubble move with the velocity of the swiftest cannon-ball, it would injure nothing that it might strike, while the seemingly almost spent cannon ball has more than once shorn off human limbs as though they had presented no more obstacle than


Acquired velocity
Feet
2 ft per sec 8 ft per sec
8 ft per sec 16 ft per sec
16 ft per sec 24 ft per sec
32.2
Equal Spaces or Times
0
1
2
3
4
0
¼
½
¾
1
Mass falling projected from zero point
Fall in one Second
Feet
1
4
9
16.1

thistle down Suppose now that a man weighing 190 pounds (about the maximum weight effective in the ring) should fall as a body falling freely near the surface of the earth, for the distance of 16.1 feet. As the moving energy of his mass would be compounded of the mass multiplied by the velocity with which it travels, it would follow that the shock at the end of 16.1 feet (which would take place in a second) would possess the momentum represented by multiplying 190 pounds by 32.2, or 6118 pounds. One, therefore, perceives from the diagram that if, for a weight of 190 pounds, a momentum of only about twice 3000 pounds is generated by gravity in a second, with a velocity *twice as great as a boxer's blow* (as it would be, if the velocity of the boxer's blow at the rate of four feet in a quarter of a second be here correctly rated), it is already demonstrated that a man of 190 pounds could not strike a blow of 3000 pounds, unless he could put his whole weight into it, when, for 4 feet, at the rate indicated, it would be 190 pounds multiplied by 16, or 3040 pounds; and putting his whole weight into it is impossible. But it is worth while to pursue the subject a little further.

Remembering what has just been remarked as to the momentum generated by the fall of a mass of 190 pounds during the first second of time from a state of rest, we must now, in order to make safe comparisons between conditions that are only analogous, not identical, begin by recognizing formally the fact that a man cannot deliver a blow involving the conditions of delivery in a second, over a distance of 16.1 feet, and with an acquired velocity of 32.2 feet. The distance concerned, to say nothing of the other differences, precludes direct comparison between the rate of the man striking and the rate due to gravity. We must therefore institute the comparison and come to a conclusion indirectly. The longest distance over which a tall man can deliver his average blow is about 4 feet. A man with abnormally long reach, like the present boxer, Jackson's, can deliver it over 4.5 feet without changing his footing. If a man delivers it 4 feet in a quarter of a second (and this I think from observation the best boxer can do), he delivers it with the velocity with which gravity would have affected any mass in the first second of time from a state of rest, that is, with a velocity of 8 feet for the half second, or 16 feet per second.

If a boxer strikes four feet in a quarter of a second, of course he strikes at the rate of 8 feet in half a second, that is to say, he strikes with the same velocity as that due to acceleration from gravity during half a second. There is, however, in this case, no question of acquired velocity, or what is otherwise known as acceleration due to terrestrial gravity. I am merely putting the two equals as derived from different sources of power in juxtaposition so as to compare and contrast them with each other and thus to bring clearly before the mind that it is not likely that any boxer's blow can have a speed essentially greater than that represented by the acceleration due to gravity in half a second, or in other words the rate of 16 feet per second. Terrestrial gravity would, as indicated, have nothing to do with the force of the resultant blow. The blow being horizontal the force of gravity with relation to it would be virtually *nil*. The statement here is limited strictly to the fact that if the boxer can strike 4 feet in a quarter of a second he can strike that distance with the momentum that would be generated by gravity in one half of a second, acting on any mass subjected to it from a state of rest.

The fact must be kept constantly in view that mass and velocity combined make momentum. With enormous weight and great slowness the effect produced is not of the nature of a blow but that of a push. With great velocity and minute weight the blow produced is slight. With both great weight and great velocity the blow becomes tremendous. Here it is well to add that the popular notion of the amount of his weight that a man can put into a push or a blow is highly erroneous. Mechanical engineers, who are continually obliged to make computations for the deployment of the force of pushing on capstan bars for drawbridges and other places, know that, unless there are cleats on the ground from which the feet can obtain some purchase, from 15 to 20 pounds is about the proper amount to allow for the push of a man working under those conditions. The question therefore remains open in every individual case, unless instrumentally settled, as to what proportion of the mass of the boxer of 190 pounds enters into his blow, and this, with different men, varies as well as the speed. But supposing, for the sake of argument and demonstration, what has already been rejected, that the whole weight of the man enters into the blow, its momentum for 4 feet, at the rate indicated, would be represented by 190 pounds multiplied by 16, or the rate of speed, at the half second point, due to the force of gravity for a first second, and would be, as already noted, 3040 pounds. A man cannot, however, as already stated, put his whole mass into a blow, because he cannot, by any muscular effort whatsoever, move freely in space. The indispensable condition of his being able to deliver an effective blow is that he shall be, as to his feet, poised on the surface of the earth. So unless, by means of electrical recording apparatus, we determine the speed of a blow, and, by means of a dynamometer, determine the moving energy of it, and deduct one value from the other, we cannot ascertain how much of the effectiveness of a blow is owing to the weight of the human body thrown into it, and how much is derived from a speed which involves the whole person—hand, arm, and trunk.

It would follow, from all the evidence at my command, that if the speed of a blow of four feet be a quarter of a second, a man of even 190 pounds in weight cannot follow up, so as to make effective in his blow, with more than 32 pounds (in round numbers, a sixth of his weight) with velocity equal to free movement of fall of a mass for the first half-second, from a state of rest, above the surface of the earth. Barrett, the late well-known teacher of boxing in Philadelphia, a man of undoubted veracity, as highly esteemed in his day and limited sphere as was, at the beginning of this century, in a more extended one, Gentleman Jackson, of England, Byron's boxing master, once told me as remarkable that he knew a man who could strike 500 pounds. This meant, of course, as tested by a dynamometer. If then, in fine, the time of a boxer's blow be a quarter of a second, the length 4 feet (which would make, as already remarked, the rate the same as that due to the effect of gravity on a mass in the first half second, fallen from a state of rest), and the proportion of his weight accompanying it be 32 pounds, he would strike with the momentum represented by 32 pounds multiplied by 16, or 512 pounds. This momentum, if the reader experienced in boxing will consider the speed here ascribed to the blow of the finest boxer, and the confirmatory evidence derived from the statement of Barrett, would seem to be very near the mark. No one will be likely to maintain, after what has been said, the possibility of striking an effective blow of 4 feet in length in less than a quarter of a second; or that, of the weight of a man of 190 pounds, more than 32 of them can be put into a blow corresponding with the rate of 16 feet per second.

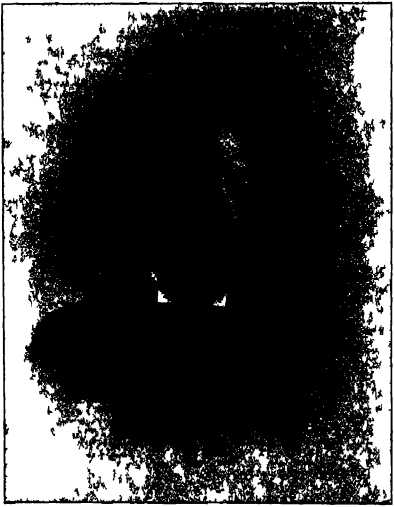
Up to the point we have reached the conclusions drawn were partly dependent upon an estimated velocity of blow, derived from observation, not experiment. But a friend having reminded me that, among Mr. Muybridge's series of photographs of movements of man and

the lower animals is one illustrating the speed of a blow, the examination of it which has followed has led to a remarkable confirmation of the preceding estimate of speed Plate No 333 of the Muybridge series represents the phases of a knockdown blow, including the effects, until the person struck is prone on his back on a mattress The intervals between the photographic phases is ninety six one thousandths of a second Three successive phase pictures, thus virtually taken one tenth of a second apart, represent the blow from start to finish In the first, the striking arm is drawn back and starting from its point of departure In the second, the arm is seen projecting about half way between the boxing opponents In the third and last phase of the blow the fist of the striker lands on his opponent The interval between the first and second phase having been virtually one tenth of a second, and that between the second and third also one tenth of a second, the blow was therefore delivered in virtually one fifth of a second Measurements on the pictures giving the successive phases show that the length of the blow from start to finish was 38 inches Here we have the rate of 38 inches in one fifth of a second We have previously used the estimated rate of 48 inches in one fourth of a second The data derived, on the one hand, from observation, and that on the other from experiment, coincide within a small fraction—within half an inch

It is open to observation that boxers who make their living by ring fighting carefully conceal from the public, knowledge of the momentum with which they can strike, although this could be easily and safely obtained, and probably often is, with the glove and dynamometer In the ring, as in many other instances in which all seems physical to the casual observer, moral elements enter The dangerousness of the man whose exact moving energy of blow is known, is to a certain extent discounted, so potent is the imagination in the affairs of men Professional fighters know, as well as every one else does, that everything unknown seems magnificent

The element of quickness in a boxer, in addition to courage, skill, strength, weight, and endurance is indispensable In the case of such men as Sandow, muscles have been trained by work so ponderous that they do not respond to the will for elastic, quick movements Men like him cannot put the same speed into their blows as can men trained as Corbett has been, nor can they put the weight of their bodies as effectively into their blows as men can who have been trained for strong, lithe movements. Consequently, the blows of such men, no matter how heavy the men are, have less power than those of men trained as boxers. So far from Sandow's being able in the ring with Corbett to break his arm or otherwise disable him, he would probably not hit Corbett a single blow, or if he did, not one that would have the effectiveness of his opponent's, because it would lack the speed and accompanying weight thrown into his by a boxer endowed with a rare combination of height, strength, weight, and reach, supplemented by agility marvelous for a large man, trained by life-practice to highest excellence within his sphere, and all crowned by the habits which promote endurance.

We should rejoice that we live in an age remote from the false sentiment of some former times, an age of revived physical culture, when it is possible to bestow undisguised admiration on physical excellence of any kind, in its sphere as fine as moral worth, of which it is in some subtle way even now partially emblematical, to become, mayhap, in the course of time, through more general observance of the laws of nature, wholly identified with it, and indivisible in attributes. Within our own time is observable a great advance in obedience to those laws. It should be evident that the almost universal admiration for physical development and prowess is not wholly derived from the combative quality of mankind, but has its root deeper in human nature, in the general interest in the health and welfare of the species. If, however, it be needed that the combative manifestation of nature be sustained on moral grounds, then is its defense easy. Inasmuch as the present stage of development is conditioned in almost every sphere of animal life on self-defense, self-preservation being still the first law of nature, all teachings which tend to suppress among men any resort to the *ultima ratio* of their kind, tend also to transform their means of defense exclusively into the meaner modes of securing it, into the adoption, to that inevitable end, of cunning and treachery, and the swarm of the meaner vices, sapping the noble elements of their nature, which must go hand and hand and stand or fall together. For my own part, I candidly avow that my observation of life from boyhood onward, derived from personal experience, from history, and from noting racial tendencies in the present era, has led me to believe that, with reprobation and repression of physical force, as potential, and therefore, if need arise, actual, in matter for which law offers no protection, nor ever will or can, must inevitably go various un-



GEORGE DE BENNEVILLE KEIM

derhandedness in the conduct of life. I firmly believe that those nations which cultivate physical development by countenancing and promoting athletic sports and contests, with due regard to the exclusion of the cowardliness of brutality, will ever possess in their citizens, as compared with those of other nations differently prompted through race, or differently controlled by law or dominant public sentiment, a greater proportion than the others of those inspired by independence of character, honor, and disposition to fairness as between man and man, constituting them relatively the more stalwart lovers and defenders of the right in every form

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Obituary Notice of George de Benneville Keim.

By D G. Brinton, M D.

(*Read before the American Philosophical Society, May 4, 1894*)

Those who have had a reasonably long and intimate knowledge of men must have observed that among the individuals prominent in the active affairs of the day there are two classes—the one, of such as are wholly absorbed in their daily pursuits, whose natures are, to use a simile of Shakespeare's, "subdued to what they work in, like the dyer's hands"—the other, who, however compulsive and harassing their avocations, retain an individual and independent freshness of personality, often strangely in contrast with the requirements of their working hours.

Distinctly to the latter class belonged our late member, George de Benneville Keim; and all who enjoyed his friendship will agree that an appreciation of his career would be imperfect which failed to present these two aspects of his character. I shall begin with that in which he was familiar to the world in general, and then I shall say a few words about him, as he was known to his friends and near associates.

Mr. Keim was a descendant in the sixth generation of Johann Keim, a member of the Society of Friends, who emigrated from the Rhenish Palatinate to the colony of Penn, and settled at Oley, Berks county, in 1704. The grandson of this Quaker emigrant was General George de Benneville Keim, an officer of note in the war of the Revolution from whom our late member derived his name The de Bonnevilles were a French Huguenot family who joined the settlement at Oley in the early years of the eighteenth century

His parents were George M Keim and Julia C Mayer At the time of his birth, the date of which was December 10, 1831, they resided in Reading, Pa There he received his preliminary education, and later was at school in Georgetown, District of Columbia At an early age he matriculated at Dickinson College, Carlisle, Pa, where he graduated in 1849, when eighteen years old

His first intention was to prepare himself as a mining engineer, and with that object in view he removed to Philadelphia and entered the laboratory of Dr Charles M Wetherill, where he engaged in the study of chemistry with especial reference to assaying and mineralogical analysis

Soon, however, his predilection for a more strictly professional life asserted itself, and in the following year, 1850 he returned to Reading, and began reading law in the office of Charles Davis Two years later he was admitted to the bar, and began practice in the same city

At that time, the titles to many of the anthracite coal bearing tracts in Eastern Pennsylvania were by no means clear, and costly and protracted litigation about them occupied the attention of the courts To these intricate questions Mr Keim early devoted himself, and rapidly acquired a remarkable familiarity with their confusing details This special knowledge brought him into contact with many prominent owners and operators, and at the suggestion of some of these he transferred his office to Pottsville, Pa, in the year 1855

Here he formed a friendship which lasted for many years and materially influenced his after life It was with Mr Franklin B Gowen, who about that time began the practice of his profession at the Schuylkill county bar They were closely associated in many important cases, and Mr Keim's intimate knowledge of most of the valuable titles in the anthracite coal basin soon obtained for him a large and remunerative practice

When the Presidency of the Philadelphia & Reading Railroad Company became vacant through the resignation of Mr Charles E Smith, at the request of the Board of Directors Mr Gowen provisionally accepted the position His remarkable abilities, forcible character and brilliant oratory commanded the admiration of all who met him, and it was not long before he was elected definitely President of this important outlet of the anthracite region. His far reaching plans were soon formulated and under the name of the Reading Coal and Iron Company a gigantic corporation was created the object of which was to control by purchase or lease, practically the whole product of the western, middle and southern anthracite coal fields.

The crucial part of this colossal undertaking—the examination of the numerous and complicated titles—was entrusted to Mr. Keim. The thoroughness with which he performed this herculean task has excited the astonishment and admiration of members of the bar ever since, for although the transfers which he passed covered about ninety thousand acres and involved many millions of dollars not one acre has been found, the title to which he approved, but that title has in every instance been confirmed by the courts in spite of sometimes strenuous litigation. It is doubtful if any other real estate lawyer in the State can approach such a record either for magnitude of transaction or uniform accuracy of opinion.

These occupations brought him constantly into relation with the affairs of the Reading Railroad and in 1871 he was appointed its General Solicitor. The calls upon his time at the central office became so frequent that, in 1874, he left Pottsville and took up his residence in Philadelphia, which city became his home for the remainder of his life.

The severe depression in business throughout the country which followed the famous crash of 1873 soon made itself felt acutely on the extensive and heavily hypothecated interests of the Reading Railroad and the Coal and Iron Company. Affairs drifted from bad to worse until, in May, 1880, both companies passed into a receivership. Mr. Keim was appointed, *pro tempore*, to that office. This threw an enormous burden of complicated and discouraging business upon him. In this position he continued until January, 1884, when a reconstruction was arranged and Mr. Keim assumed the Presidency of both companies. This phase lasted but a short time, and in June of the same year both companies again passed into the hands of receivers, of whom Mr. Keim was one, and in that condition they remained until January, 1888.

During this trying period Mr. Keim made every effort to sustain the financial integrity of the companies, to guard their disburse ments, and to protect the interest of those whose investments were in them. He steadily resisted the pressure brought to bear upon him to authorize foreclosure proceedings, and what was to him probably the most painful of all the sacrifices he was called upon to make, rather than violate his sense of duty to those who had entrusted him with this great responsibility, he renounced the ties of long and closest friendship

This receivership ended at the beginning of 1888, when Mr. McLeod was elected President of the Reading Railroad and Mr. Keim of the Reading Coal and Iron Company, and a member of the Board of Managers of the Reading Railroad Company He resigned from both these positions some time before his death, but up to that event was a Director of the Baltimore and Ohio Railroad Company.

Some idea of the magnitude of the business which devolved upon him during his second receivership may be derived from the official statement, that in that period the gross earnings of the companies were about $150,000,000.

For some years before his decease Mr Keim had been subject to periodical attacks of arthritic disease, which had doubtless left their impress on the arterial walls and predisposed him to apoplectic seizures. He had visited Europe several times in order to avail himself of the benefits of some of the health resorts recommended for such cases. On Saturday, December 16, 1893, while engaged in some business transactions, he was suddenly seized with vertigo and allied symptoms. He was conveyed to his home and prompt aid was summoned, but in vain. The attack was rapidly progressive, and terminated fatally on the morning of Monday, December 18.

In spite of the absorbing nature of his professional duties, Mr. Keim found leisure to read extensively in general literature and to take a broad and real interest in the progress of thought and culture. The history of his native State and country possessed an early and lasting attraction for him. He was elected a member of the Historical Society of Pennsylvania, December 12, 1853, and was chosen Vice-President, May 1, 1876, to which office he was continuously reëlected up to the time of his death. He was Trustee of the endowment fund, to which he was also a liberal contributor, as he was likewise to the other needs of the Society. Though a regular and interested attendant at the meetings, he was not a writer for the Society's publications.

When the Governor of Pennsylvania was requested by the Legislature to appoint a Commission who should select two distinguished Pennsylvanians as subjects of statues to be presented by the State, and placed in the Capitol in Washington, Mr. Keim was one of those entrusted with this delicate decision The two decided upon were General Peter Muhlenberg and Robert Fulton, and this selection met with the general approval of the people of the State

Mr. Keim was elected a member of the American Philosophical Society, April 21, 1882. He was frequently present at its meetings, and manifested an active interest in all questions touching its welfare, as well as in many of those of a scientific character brought before its sessions.

Throughout his life he was a lover of books, especially those relating to history and classical English literature His library was large, and displayed sound judgment and good taste in the selection of its contents In it, he often sought and always found a welcome relief from the harassing routine of his daily duties.

Professionally, his strength lay in his profound acquaintance with real-estate law and his accurate estimate of the bearings of precedents. He was not a jury lawyer, and he always felt a hesitation in addressing an audience. Although remarkably able in drawing up a lucid and convincing statement, whether in matters of business or purely technical, a certain timidity of temperament prevented him from becoming an orator. In this he was in singular contrast to his partner, Mr. Gowen.

The ennobling inspirations of domestic life were deeply appreciated by Mr. Keim. In early life he married Miss Elizabeth C. Trezevant, only daughter of Dr. Louis C. Trezevant, of South Carolina His widow and two daughters survived him.

In the calm pleasures of the home circle he delighted to pass the hours when business calls ceased their demands For this reason, he was less frequently an attendant at public receptions and entertainments than many of his fellow-citizens holding similarly prominent positions.

Throughout his extremely active life and his constant dealing with questions of magnitude and difficulty, Mr. Keim retained the unvarying respect and generally the warm affection of those with whom he was thrown in contact. His characteristics were entire honesty and sincerity, a simplicity of manner which led him to treat all, no matter what their station in life, with equal courtesy, and a clear, sound judgment, which guarded him from the imposition of the fraudulent or the flattery of the interested. To use the expression of one who knew him long and well, Mr. Charlemagne Tower, Jr, "the leading traits of his private character were honor and loyalty" His charities were unostentatious, but large and constant. One of his old friends writes me that he personally knows of several whom Mr. Keim regularly assisted, and who depended on this assistance for much of the comfort of their lives.

While his acquaintances were numbered by thousands, his intimates were few Although affable and ready of access, it was not at all easy to understand his real nature, nor to approach his inner personality A peculiar dry humor, an odd candor of expression, foiled the importunate and disarmed the aggressive. Under the appearance of a certain levity of language and manner he baffled those who attempted to transgress the lines which he had drawn around his intimate life. The impression thus created was so different from that usually expected from a man bearing such heavy burdens of responsibility, that it always at first puzzled, if it did not even disappoint, those who knew him but slightly. Behind this outward habit of encounter, however, was a keen, penetrating judgment and a warm, sympathetic nature, fully recognized and appreciated by those who understood the thoroughness of his work and the spirit of his actions. By his death our city lost a distinguished and worthy citizen, his friends one always dear to them, and this Society an estimable and interested member.

Some New Red Horizons.

By Benjamin Smith Lyman.

(Read before the American Philosophical Society, May 18, 1894.)

It seems to be worth while to give, at least roughly and in part conjecturally, some idea of the relative geological position of the different horizons from which fossils have been reported in the so-called American New Red of the eastern part of the United States; for it will thereby be seen how completely and naturally the recently discovered, unexpectedly great, and consequently perhaps not readily accepted, thickness of the New Red in Montgomery county, Pa., harmonizes with all the hitherto publicly recorded facts in other States It is true the imperfection of the records will make the present attempt somewhat conjectural, but there is reason to hope that it may keep well within the not wholly unprecedented New Red proportions of two bushels of conjectures to two grains of fully ascertained facts

Indeed a great share of what has been voluminously written about the New Red is a mere tissue of conjectures one part depending on another, but if their connection be traced from one to another it will be clear that the starting point or original support of them all is the supposed fact superficially and inaccurately observed and in any case not necessarily conclusive, that the beds in question were at the outset wholly or almost wholly, of a red color To be sure dark colored beds were seen here and there, but were supposed to have become so by the baking of neighboring exposed or subterranean trap They were sometimes called indurated shales ' though miles away from any visible trap and their existence above trap beds even at some distance was considered by the most skeptical to be sufficient proof of the intrusive character of the trap

The next conjecture was that as the beds were all red or originally so they must be of one narrow paleontological period a conjecture favored by the circumstance that fossils were not very numerous and in fact, as we shall presently see, were confined in great measure to a very limited portion of the whole series They were all referred indiscriminately to the series merely as a whole, and any diversity of character was overlooked or violently disregarded, and they were by circular reasoning pronounced incapable of belonging to species foreign to that small period Then it was conjectured that during one narrow paleontological period no very enormous thickness of beds could possibly have accumulated not more than, say, 3000 or 5000 feet Then, again, it was conjectured that a series of at the most, such moderate thickness might well exist in full extent within very small geographical bounds that in short it was as has been said of the soul in the human body 'all in every part, ' and was equally complete in Massachusetts Connecticut New Jersey Pennsylvania and in the Richmond (Va) coal field The result of borings in that field occasioned the conjecture that the whole New Red series was only 1500 feet in thickness, even in Pennsylvania, and there was probably surprise at finding a boring could be 3000 feet deep without reaching the bottom of the series at Northampton, Mass , where an unprejudiced tyro in geometry might have predicted the result as not improbable from the exposed dips The idea, however, had by frequent repetition become fixed, though in reality a mere conjecture, that the total thickness must be small, and hence came the unhesitating rejection of the apparent thickness of 14,000 feet in New Jersey and 55,000 feet in Pennsylvania, in spite of their being in truth arrived at by the only means based on published facts then possible, namely, the estimated average dip and the whole geographical breadth of the series Although then, the estimates of the total thickness have varied from 1500 to 55,000 feet with some slight support from observed facts, it has become a heresy to maintain a thickness different from the still more purely conjectural one of between 3000 and 5000 feet.

Then naturally followed conjectures to account with that moderate thickness for so great a geographical breadth in spite of the known dips. These conjectures have been ingenious and elaborately argued and zealously adhered to, but have one by one been disproved or found to be at best only imperfectly supported by observation It was thought that the dips might be merely apparent or due to false bedding, deposition on a sloping surface, but the thin-leaved, shaly character of some of the beds and the position of the pebbles, ripple marks and fossil footprints have shown the impossibility of that supposition It was further conjectured that a series of great parallel longitudinal faults with downthrow constantly in one direction might diminish the thickness to the required extent, but their main support was the very insufficient one that recurring hard beds or parallel hills had a similar red color A careful consideration of the very much curved strike of the beds in some parts of Pennsylvania and New Jersey shows that no series of parallel great faults would help the matter Besides, although faults of a few feet or yards are numerous, their direction is not generally longitudinal nor the downthrow uniformly in one direction, and but one great fault has yet been proved to exist, and that only in Pennsylvania and New Jersey, and by no means generally longitudinal

Conjectures in regard to the trap, supposed to be so important in "indurating" and darkening the New Red, have been, if possible, even more wild and needless. The impression seems generally to have been very strong that every mass of trap must be a dike, and that if it was undeniably interbedded conformably with the shales, it must necessarily be a dike that closely followed the bedding intrusively, no matter how many miles, no matter how soft the shales, no matter how gentle the dip Sometimes it was preposterously suggested that the trap had occasioned the dip of the shales, both near to it and far away. But, in general, as much advantage as possible was taken of the dip, and the trap supposed to be intruded after the dip had been fully acquired, quite dissociating certain sheets of trap from the age of the New Red sedimentary beds with which all the trap is otherwise so closely connected, and not considering that the dip is even now probably still in process of gradual acquirement, or by occasional small fits and starts (witness the earthquake that was felt only the other day between Lambertville and Flemington, N. J , near the line of the great fault there, and corroborative of the existence of the fault at the place pointed out in a former communication, *Proc. Amer. Philos. Soc* , Vol. xxxi, p. 314). Yet, as the dip alone is so gentle that a dike following it must have come from many miles' distance to have originated at a depth great enough to be melted, and could hardly be supposed to refrain for so long a space from sometimes breaking across the soft shales by a short cut to the surface, it was imagined that the dike must be nearly vertical at a short distance below the outcrop. Then as the outcrop was sometimes (for example in the case of the Palisade trap) more than fifty miles long and as crooked as a ram's horn ' the vertical parts of the dike must by a marvelous coincidence have followed the same curves *Credat Judæus Apella non ego!* Really such a belief seems to require an amount of credulity hardly consistent with the modern scientific spirit that hesitates to accept extraordinary explanations where ordinary ones can be found to answer the purpose

The intrusive conjecture has in fact been in great part rejected but not hitherto for the Palisade trap owing to certain observed facts Still it seems not at all impossible to account for them so far as recorded much more easily and naturally than by the well nigh supernatural intrusive theory If the trap appears in one place to cross the sedimentary beds on one side why may it not be either the side of a dike (for of course every overflow must come from a dike somewhere) or merely an evidence of the erosion that took place before the trap overflowed, just as in the case of the 'horsebacks or "rock faults in coal mines a small valley in the original coal marsh has been filled with sand or silt? If there be here and there a branch from the bottom of the trap sheet running a short distance into the sedimentary beds is it not as easily conceivable in the case of an overflow as in that of intrusion? Is it wholly inconceivable that apparently similar branches from the upper surface of a trap overflow sheet into the sedimentary beds might sometimes occur though none are positively recorded? If there be indurated shales above some of the Palisade trap is it not quite possible in case of real induration that there be another overlying unexposed bed of trap that may have caused it especially as there is other evidence of interbedded shales? The intrusion conjecture is beset with so many serious difficulties, and the overflow theory with so few the choice between them seems easy A vast amount of ingenuity has been expended in trying to reconcile observed facts with the intrusive theory, while immensely less skill is required to show the consistency of the facts with the overflow principle

The New Red theory with its conjectures and arguments both for the trap and the sediments might well be called the tennis ball of American geologists or a domestic appliance for mental gymnastics requiring the minimum of work in the field Nevertheless the fabric, composed as we have just seen, in the main wholly of conjectures based one upon another, without having at the bottom one single substantiated fact has with the lapse of time become so consolidated and in its older parts, dating from the early infancy of geology in America, has become so venerated that it may now be considered to be a fully ' accepted fable " The hand that attempts to disturb it may probably be regarded as sacrilegious, and arguments against it, though thoroughly founded on facts, will be looked on with more suspicion than new conjectures would be if only consonant with the old baseless ones But however stubbornly skeptical the public may be in refusing to put faith in the present conjectures, well supported by many observations, instead of the old ones supported only by other conjectures, there may yet be found some convenience in the present collation of facts.

New conjectures are still necessary owing to the imperfection of the record of facts outside of Pennsylvania Although the New Red stretches for hundreds of miles close past some of the most populous parts of America, the probable economic resources never seemed enough to secure its thorough examination and a publication of the results. Even as regards field work it has been a sort of play-ground for geologists rather than a place for thoroughgoing investigation The State governments to this day, with all their surveys, have never fully provided the means for such work What little field work has been done, outside of Pennsylvania, has been, in great part, carried out with the exaggerated idea that the geology of a region can be studied out merely by a comparison of the fossils, a far shorter and easier way than the laborious methods of properly geological observation and collation Such purely paleontological geologizing may be likened at its very best to the rapid hypsometrical work of the aneroid instead of the spirit level, and exclusive dependence on the fossils for geological indications may be compared with confiding in pocket aneroid work more than in railroad leveling. Furthermore, the paleontologists have not merely altogether neglected to plot numerous dips as an indication of geological structure, but they have not generally thought it worth while to indicate with any sort of precision the beds that have yielded their fossils, though Fontaine has done something of that kind Wheatley, alone, gave a measured columnar section of about 180 feet, showing clearly the position of his fossils, but he must have been more a geologist than a paleontologist.

The Pennsylvania foundation of the present conjectures is, however, far from conjectural. We are not here entering upon another system of conjectures based on conjectures, but conjectures based at least on facts; and it is to be hoped that the conjectures themselves may prove to have nothing improbable, violent, unnatural or supernatural in them. The unexpectedly great thickness of the New Red in Montgomery and Bucks counties is not conjectural, but has been ascertained by means of much careful, laborious, time taking work in the field and in the office. Something like one half of the field was excellently mapped with ten-foot contour lines by the Philadelphia Water Department several years ago, and the rest was roughly contoured expressly for the New Red investigation, and the completed map of it was in part replaced by some United States geological work just then published Some two thousand dips were plotted on the map. Some two thousand rock exposures, including all the railroad cuts and many long river-side cliffs, were observed, measured roughly and drawn in columnar section to scale. Besides the written description of each rock-layer, some four thousand rock specimens were taken for a more complete understanding and for comparison one with another. A general columnar section was formed by combining the separate ones, computing the intervals between them, having due regard to the dip, strike and elevation of each exposure, and proceeding from point to point between the nearest ones, so that no essential error could occur from changes of dip or strike in so small a space, and checking occasionally the computation between two distant points over one route by like computations over another route, with the aid sometimes of a comparison of specimens to identify the beds of one observed section with those of another. The topographical features of the country also aided in working out the structure A complete publication of all the evidence would have been more costly than perhaps at present desirable, and certainly more so than the funds at hand would permit, but it is hoped that the map and cross-sections just now about to be published will be found to contain enough of the facts to be fully convincing of the substantial accuracy of the results The map was taken in hand by the lithographer over a year ago, and its publication is now almost daily expected, and may take place before this paper can be printed, so that it is not necessary to give here a map or sections of the Pennsylvania portion of the New Red.

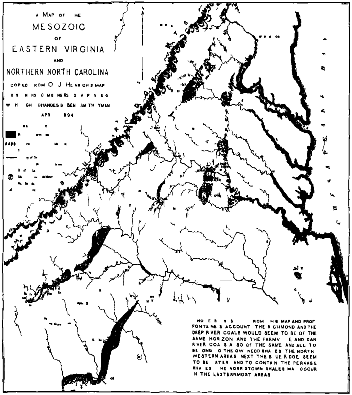
The survey, then, has shown that the so-called New Red in Montgomery county is at least some 27,000 feet thick, and that it may be divided into five parts as follows, from above downwards shales mostly soft and red, at Pottstown and northeastward, about 10,700 feet thick, shales, in great part hard and green, partly blackish, and dark red, at the Perkasie tunnel and near it, with some small traces of coal, about 2000 feet; shales, mostly soft and red, at Lansdale and near it, about 4700 feet; shales, in great part hard, dark or greenish gray, and blackish, partly dark red, at the Gwynedd and Phœnixville tunnels, with traces of coal, about 3500 feet; shales, mostly soft and red, but in small part dark gray, or green, or blackish, with some beds of brown sandstone and of gray sandstone and pebble rock, at Norristown and eastward, about 6100 feet. That is, in the main, two sets of hard dark shales, with soft red shales above and below each, and the lower set of dark shales thicker, blacker and more carbonaceous than the upper one. Nevertheless, the resemblance of the two sets and the fact that, owing to the great fault, both occur twice near the Delaware have occasioned some confusion. It would probably be fruitless to attempt at present outside of Bucks and Montgomery counties to identify more definite horizons than these five great bodies of rock; and it must still be only with more or less of conjecture that even they can be traced into distant States by the maps and descriptions that have been published.

Even in Pennsylvania, outside of those two counties, the published information is too defective for the purpose. If the State government had ever made possible a topographical survey of the whole field, it might probably be comparatively easy now to trace each subdivision by the help of the topography all the way to the Maryland line. As it is, we can only conjecture roughly the horizons of the fossils that have been found. For example, it is very probable that the vertebrate fossils near Emigsville, York county, came from the Gwynedd shales, for the place would seem to be not far from the horizon of the coal near Liverpool, close by, that most likely corresponds to the other Pennsylvania traces of coal in the Gwynedd shales and to the more abundant Richmond and North Carolina coals The fossil algæ of A Wanner, four miles "eastward" from the Goldsboro fossil footprints, in York county, would also seem to be near the Liverpool coal and likewise in the Gwynedd shales, perhaps higher up than the vertebrate fossils The footprints and algæ described by A. Wanner as about a mile south of Goldsboro, would then seem likely to be in the Lansdale shales, perhaps towards the top of them

In Virginia, it is doubtful whether the total New Red thickness is anything like so great as in Pennsylvania, but, according to Fontaine's description (*U S Geol Survey*, Monograph, 1883, vi, 6), there would seem to be representatives there of all five divisions, with a confusion of the two sets of dark shales, on account of their occurring quite disconnectedly one in the eastern and the other in the western areas The accompanying map, copied from Oswald J Heinrich's map in the *Transactions of the American Institute of Mining Engineers*, Vol vi, Pl v, 1879, with the slight change of omitting certain misleading symbols and adding some names of fossil places, will perhaps sufficiently show the geographical position of the New Red in Virginia and North Carolina

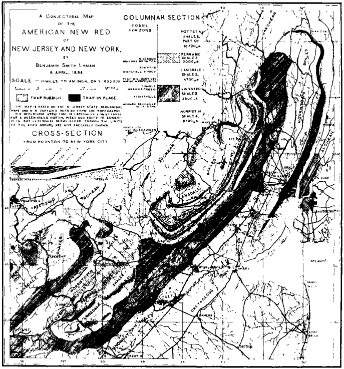
Fontaine says (p 6) "The strata of all the areas may be divided into three groups, and this division is most marked in the two eastern coal-bearing areas [the Richmond basin, including the barren Hanover county portion at its northern end, and the Cumberland, or Farmville, basin]. The coal in these occurs in the middle group and is accompanied by a large proportion of black shales The lowest beds of the two coal-bearing areas are sandstones and shales of a predominant gray color, but with some red strata The Cumberland area contains much more of them [the red] than the Richmond area . . The more western areas . . . . show also the threefold grouping of the strata, but in a less marked manner Where plants and traces of coal occur in them they are found in the middle member. This member contains a comparatively small amount of red beds. The beds are here often gray or greenish gray. The lower group of these areas is usually characterized by the large amount of red strata present and the absence of traces of vegetable matter, except silicified wood. The upper group or member varies in character with the locality, but . . the beds are usually barren sandstones and shales, formed of well-sorted components."

It seems highly probable that the middle member of these western areas, near the Blue Ridge, in Northern Virginia, is the same as the Perkasie shales and that the middle member, at least, of the Richmond and Farmville coal fields corresponds to some part of the Gwynedd and Phœnixville shales, notable in Pennsylvania, even, as containing some thin coal beds. Indeed, it is possible that the whole of the Mesozoic of those two fields may be included in the Gwynedd shales.



A MAP OF THE
MESOZOIC
OF
EASTERN VIRGINIA
AND
NORTHERN NORTH CAROLINA
COPIED FROM O. J. HEINRICHS MAP
IN TRANS. AM. INST. MIN. ENGRS. VOL. XVII, P. V. 69
WITH SLIGHT CHANGES BY BENJ. SMITH LYMAN
APRIL 1894

NOTE BY B. S. L. FROM THIS MAP AND PROF. FONTAINE'S ACCOUNT THE RICHMOND AND THE DEEP RIVER COALS WOULD SEEM TO BE OF THE SAME HORIZON AND THE FARMVILLE AND DAN RIVER COALS ALSO OF THE SAME, AND ALL TO BELONG TO THE GWYNEDD SHALES. THE NORTHWESTERN AREAS NEXT THE BLUE RIDGE SEEM TO BE LATER AND TO CONTAIN THE PERKASIE SHALES. THE NORRISTOWN SHALES MAY OCCUR IN THE EASTERNMOST AREAS.


A Conjectural Map
of the
AMERICAN NEW RED
of
NEW JERSEY AND NEW YORK,
by
Benjamin Smith Lyman
6 April, 1894
SCALE — 10 MILES TO AN INCH, OR 1 : 633 600
TRAP RUBBISH
TRAP IN PLACE
THE MAP IS BASED ON THE N. JERSEY STATE GEOLOGICAL MAPS AND H. D. DARTON'S WITH AID FROM THE TOPOGRAPHY. THE GEOLOGICAL STRUCTURE IS ESPECIALLY CONJECTURAL FOR A DOZEN MILES NORTH, WEST AND SOUTH OF SOMERVILLE, BUT ELSEWHERE SEEMS CLEAR THOUGH THE LIMITS OF THE ROCK GROUPS ARE NOT PRECISELY KNOWN
CROSS-SECTION
FROM BOONTON TO NEW YORK CITY
COLUMNAR SECTION
FOSSIL HORIZONS
N. VERNON
MILFORD BOONTON
POMPTON
WHITEHALL N. PROV
BLUE MIN. MARTINSV
TUMBLE
WASH'N X ROS'G
PHINESVILLE
NEWARK BELLEVILLE
WILKINTHA
SNADY SIDE
AND WEEHAWKEN
POTTSTOWN SHALES, PART OF 10700 ft
PERKASIE SHALES 2000 ft
LANSDALE SHALES, 4700 ft
GWYNEDD SHALES 3500 ft
NORRISTOWN SHALES, 6100 ft
ARCHEAN
SHALES
NORRISTOWN
PALEOZOIC
LANSDALE
CRETACEOUS
CRET
ATLANTIC
SANDY HOOK
LONG BRANCH
NEW YORK
TRENTON
40
30
20
10
75°
74°

The Virginia fossils mentioned by Fontaine, forty two species of plants, all appear to have occurred within the extreme limits of the coal bearing beds of the middle member of the Richmond and Farmville basins, that is, within a thickness of about 150 feet, and, beyond a doubt, within what corresponds to the Gwynedd shales.

In North Carolina, the composition of the Mesozoic would seem to be very like what it is in Virginia, with three members in the eastern Deep River coal field and three in the western Dan River coal field, each field with its middle member comparatively blackish or greenish and slatelike, with conglomerates and sandstones below, gray, brown and red, and with similar soft and hard red, brown and mottled sandstones above. The description applies more particularly to the Deep River field, but the rocks of the Dan River field are said to be similar and to consist of the same members (see Emmons as reported in *Macfarlane's Coal Regions of America*, pp 518–520, 526). Moreover, the geographic position of the two fields would seem to make it highly probable that the Deep River rocks would correspond to those of the Richmond coal basin, and Fontaine considers them to do so. The Dan River beds, however, would seem to correspond with those of the Farmville basin, that is, to be the same beds as the Richmond and Deep River beds, but on the western side of an anticlinal. Both the Deep River coals and the Dan River coals would then belong among the Gwynedd shales. It is true, Emmons later considered the lower part of the Deep River darker member to be unconformable and much older, even Permian, and called it the Chatham series, but Fontaine finds nothing in the fossils to confirm such a suspicion.

The North Carolina fossils mentioned by Emmons all come from the Deep River coal field. Only four of them come from what he calls the bituminous slate group of the Chatham series, beds most closely connected with the coals and corresponding, in Fontaine's opinion, to the beds associated with the Richmond coals, the same probably as the middle member of the Richmond coal basin and a part of the Gwynedd shales. The thirty-six other fossil plants all come from higher up, but from what seems to correspond to the middle or upper part of the Gwynedd shales within, say, at most 2000 feet above the coal beds, and below the thick, "red marly sandstones," that may correspond to the upper part of the Gwynedd shales or to the lower part of the Lansdale shales. The North Carolina fossils then all appear in any case to belong to the Gwynedd shales.

As regards the New Red in New Jersey, it was suggested in the previous communication already referred to that possibly a careful study of the topography as set forth in the valuable maps of the New Jersey State Geological Survey might enable the New Red main subdivisions to be traced quite across the State. Later, on actual trial, it did seem possible to accomplish so much rather satisfactorily, and the accompanying map of the New Jersey and New York New Red gives the result. The geological structure is nearly everywhere quite clear; only within a semicircle for a dozen miles north, west and south of Somerville the indications are not quite certain, and more thorough field work is especially desirable there. Elsewhere, too, the limits of the different subdivisions cannot be supposed to be very precisely marked In the main, however, the geological structure given in the map seems unquestionable and unmistakably confirmed by the published dips, by the topography, by the trap sheets and by the perfect correspondence and harmony throughout of one part with another.

It is readily seen from the map and its sections that the fossil horizons of Weehawken and Shadyside belong to the lower part of the Norristown shales, and the horizon of Newark and Belleville to the upper part of the same, as indicated also by the close lithological resemblance of the brown building stone of these places to the stone found in Pennsylvania only at that horizon, particularly at the Yardleyville, Newtown and other quarries. The Wilburtha fossils opposite Yardleyville on the Delaware obviously belong to nearly the same horizon.

The Klinesville fossils come clearly from the Gwynedd shales, apparently a little below their middle, and the fossils found near Washington's Crossing and Tumble Station must be from near the top of the same shales. The fossils of Little Falls, Pleasantdale, Feltville, Washingtonville, the Field Copper Mine near Warrenville ("near Plainfield," of Newberry), are all evidently close to one horizon, and that probably in the Lansdale shales near their bottom. The fossils of Martinsville and Pluckamin are perhaps slightly higher up in the same division , those of Whitehall and New Providence apparently at about one horizon slightly above the middle of that division, and those of Pompton Furnace still higher towards the top of the division. The fossils of Boonton would seem to be of about the same horizon as those of Milford in the Perkasie shales, near the bottom; and those of New Vernon slightly higher in the same shales.

It may be noticed that the map represents the trap in place as generally much less extensive than it is commonly given in New Jersey geological maps It appears to have been customary, both here and in the Connecticut Valley, to infer the existence of solid trap everywhere beneath the surface exposures of trap bowlders and decomposed trap earth. From observations in Pennsylvania, however, it seems far more probable that the solid trap in place is of much narrower dimensions, as often appears where streams have cut their way through hills. It seems quite natural, too, that so hard a rock as the trap generally is should be left by the erosion in the form of hills, standing out prominently above the neighboring spaces that are underlain by the comparatively unresisting sedimentary rocks, chiefly soft shales. It is also quite natural that abundant remains of broken blocks or bowlders and decomposing earth from the trap, so durable is it, should long exist not only beneath the places where its solid bed once lay, but also be carried by the eroding waters to some little distance in other directions from the outcrops of the solid undisturbed trap The surprising thing indeed is perhaps that the trap hills are not more prominent in the midst of such soft rocks and that the trap bowlders and gradually decomposing rubbish should not have accumulated to a still greater extent The explanation no doubt, is that the trap with all its hardness and in human experience durability is yet in geological ages comparatively easy of decomposition At some places it is obviously decomposed almost to incoherence in large masses yet in place only made visible by railroad cuts It has therefore seemed advisable to mark the trap as solid in place only where it appears to have occasioned hills of some prominence and even so the true extent may have been exaggerated particularly, perhaps in the case of the Palisade trap along the Hudson river where there may well be concealed important beds of shales between separate sheets of trap

It will be seen from the map that not all of the trap is in overflow sheets but that although none of it appears to be in intrusive sheets, there are some dikes cutting across the sedimentary bedding Surely that is not to be wondered at, and it is not surprising that such cases of dikes should occur more numerously among the older sedimentary beds For those parts of the field are the ones where the upper beds have been wholly carried away by erosion and with them whatever overflow sheets may have been supplied by the still remaining dikes

The map shows that in New Jersey the same as in Eastern Pennsylvania the structure of the New Red is much less simple near its northwest border than towards its southeast and that the old idea of nothing but northwesterly dips is far from correct

It is noticeable that the thickness of the New Red is much less towards the northeastern end of the field than it is near the Delaware and especially less than in Montgomery county, Pa , and that the diminution is occasioned by the absence of the upper beds while the lower ones do not seem to vary very greatly in amount

The diminution extends into Connecticut in greater degree and still more so in Massachusetts as is to be seen in the accompanying map of the New Red there It is possible that the idea of the very limited paleontological range and thickness of the whole American New Red may have largely originated in the small extent of the Massachusetts and Connecticut series the earliest to be studied Another error may perhaps be traced in great part to the same source The New Red namely, is persistently called New Red sandstone though in Eastern Pennsylvania a very small part of the beds, perhaps hardly one twentieth, are sandstone, and the rest are all shales or at most sandy shales In Massachusetts, however, a much larger share of the diminished series would appear to be sandstone, and that fact, together with the time-honored name of the English New Red sandstone was doubtless the cause of giving what is lithologically so inappropriate a name to our American rocks

The accompanying little map of the Connecticut and Massachusetts

New Red is compiled from the United States Geological Survey topographical sheets so far as published (some parts of the Connecticut field being deficient), and from Percival's geological map of Connecticut, of 1842, and Prof. Emerson's map of the Massachusetts New Red, and Prof Davis' partial mapping of the Connecticut New Red, but a number of changes have been made according to the indications of the topography. These geological maps gave, for our present purposes, chiefly the outside limits of the New Red and the occurrences of trap The topography seemed to indicate clearly the necessity of reducing the extent of the trap, in some places very much, and, even as now drawn, the breadth of the trap may be, strictly speaking, somewhat exaggerated, though probably harmlessly so and not inconveniently for better conspicuousness. Notwithstanding the short-sighted niggardliness of the Connecticut government of the time, that did not enable Percival to give in his report more, he says, than "a hasty outline, written mainly from recollection," of his ample field observations, his map has been the great authority for the Connecticut New Red, but it is painful to find that the base itself of the map is extremely inaccurate, not unlike other maps of that date, and even later, in States further west and south It is probable, also, that he considered every bowlder of trap to indicate that solid trap in place lay immediately below; and consequently many of his trap masses have no corresponding topographical indications Prof. Davis has already made some just criticism of the map, and, for example, has said · "that the little ridges north of Toket mountain, marked with much detail of curvature on Percival's map, are disappointing when examined on the ground" (*U S. Geol Survey*, 7th Ann Rept, p 481) It seems highly improbable but that many of the numerous marks for trap on Percival's map cannot represent trap in place. In Eastern Pennsylvania, quite outside the region of glacial drift, exposures of trap in place are very rare, and it is not easy to suppose that they can be anything like so common as his map would seem to indicate in a region heavily covered with drift. It has consequently seemed proper enough to omit many of his smaller trap masses from the present map, wherever there was no topographical feature to corroborate their existence. The lack of the New Haven topographical sheet, not yet published, has perhaps led to the omission of some of the little trap masses that might have been inserted, but they would not be important for the present purpose

As Prof. Davis has justly remarked, many of Percival's curves in the trap are simply the result of variations in the shape of the surface of the ground, where the outcrop of a bed or sheet, dipping gently, retreats as it sinks into a valley, or advances as it climbs a hill, and such curves may be properly retained. But some of Percival's curves do not seem to have any real support in the topography; and at other places, for example, north of Middletown, the topography gives quite a changed interpretation for the structure. In Massachusetts, too, near Mt. Toby and at the eastern end of Mt. Holyoke the topography seems to require the changes that have been made in the mapping of the trap.

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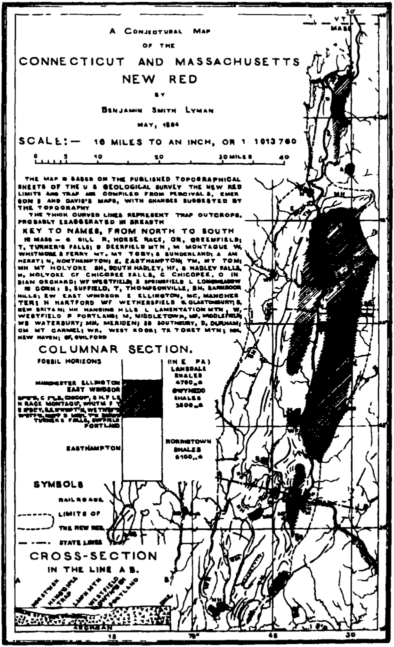

A CONJECTURAL MAP
OF THE
CONNECTICUT AND MASSACHUSETTS
NEW RED
BY
BENJAMIN SMITH LYMAN
MAY, 1894

SCALE:— 16 MILES TO AN INCH, OR 1 1013760

THE MAP IS BASED ON THE PUBLISHED TOPOGRAPHICAL SHEETS OF THE U S GEOLOGICAL SURVEY THE NEW RED LIMITS AND TRAP ARE COMPILED FROM PERCIVAL'S, EMERSON'S AND DAVIS'S MAPS, WITH CHANGES SUGGESTED BY THE TOPOGRAPHY

THE THICK CURVED LINES REPRESENT TRAP OUTCROPS, PROBABLY EXAGGERATED IN BREADTH

KEY TO NAMES, FROM NORTH TO SOUTH

IN MASS — G GILL R, HORSE RACE, GR, GREENFIELD; T, TURNER'S FALLS; D DEERFIELD MTN , M MONTAGUE W, WHITMORE'S FERRY MT, MT TOBY; S SUNDERLAND; A AMHERST; N, NORTHAMPTON; E, EASTHAMPTON; TM, MT TOM; MH MT HOLYOKE SH, SOUTH HADLEY, HF, S HADLEY FALLS, H, HOLYOKE CF CHICOPEE FALLS, C CHICOPEE, O INDIAN ORCHARD; WF WESTFIELD; S SPRINGFIELD L LONGMEADOW

IN CONN: S, SUFFIELD, T, THOMPSONVILLE, SH, BARNDOOR HILLS; EW EAST WINDSOR E ELLINGTON, MC, MANCHESTER; H HARTFORD WF WETHERSFIELD G GLASTONBURY; B, NEW BRITAIN; HH HANGING HILLS L LAMENTATION MTN , W, WESTFIELD P PORTLAND; M, MIDDLETOWN, MF, MIDDLEFIELD; WB WATERBURY; MN, MERIDEN; SB SOUTHBURY, D, DURHAM; CM MT CARMEL; WR, WEST ROCK; TK TOKET MTN; NH, NEW HAVEN; GF, GUILFORD

COLUMNAR SECTION.

SYMBOLS

CROSS-SECTION
IN THE LINE A B.

The map shows, in spite of some uncertainty about the true limits of the different subdivisions of the shales, that the quantity of the New Red that occurs in Connecticut and Massachusetts is probably decidedly less than in Central New Jersey, and that the diminution is still most likely due, not to a proportional thinning of the several subdivisions, but to the total absence of the upper beds, leaving the lower divisions apparently not very different in thickness from what they are in Eastern Pennsylvania. Their thickness, however, needs to be determined with more precision by a closer consideration of the hitherto only scantily published dips. Owing to this evident diminution of the total thickness, it is not necessary to retain, with reversed throws, the series of parallel longitudinal faults that has been proposed for Connecticut.

The geological structure indicated by the map seems very natural and quite in harmony with all the recorded facts and to make no serious fault necessary The dips near Middletown and Portland and westward would seem to be very gentle, and "occasionally westerly" (J. D Dana, *Am. Jour Sci*, 1891, Vol xlii, p 446), so as to justify the indication given of a very shallow basin there, bringing quite naturally the brownstone of the Norristown shales to the surface at Portland There seems to be another narrower shallow basin or two just west of that one A very low anticlinal (not a great fault) north of Meriden apparently enables the same brownstone to crop out so far north as Longmeadow, in the southern edge of Massachusetts The geological structure towards the eastern edge of the New Red, to the dip, seems to be much more complicated than towards the western edge, just as in New Jersey and Pennsylvania it is so along the western edge, to the dip there.

The fossil horizons can be estimated roughly, but probably without very great error The Easthampton (Mass) fossil would seem to have come from somewhere near the middle of the Norristown shales; the Portland fossils from the same shales, somewhat nearer their top, and the fossils from the west bank of the Connecticut at the Enfield bridge in Suffield, and those of Turner's Falls again from the same shales, perhaps still closer to the top. The fossils of the small detached area at Southbury also belong probably to those shales, but possibly a little higher The fossils of Durham, Middlefield, west of Middletown, Westfield (Conn.), Wethersfield, Mittineaque Falls in West Springfield, southeastern Northampton (close above Holyoke), northern South Hadley, Whitmore's Ferry (in Sunderland), Montague and the Horse Race (on Connecticut river in Gill), all seem to belong very closely to one horizon, and that just above the bottom of the Gwynedd shales. The fossils of Chicopee and those between Chicopee and Springfield (possibly those of Springfield, too, if not a little lower) and those of South Hadley Falls would seem to be from the same shales slightly higher up; and the fossils from Chicopee Falls again from the same shales, possibly still slightly higher up; and those from Amherst perhaps yet higher. The fossil bones from East Windsor would appear also to come from the Gwynedd shales, but near their top; and those from Ellington and Manchester probably from just below their top Almost all the New Red fossils in these two States then seem to have come from the Gwynedd shales as we have seen is the case in the other States

It may be worth while to give here lists of all the recorded New Red fossils arranged according to the different horizons for the sake of easy comparison beginning at the bottom and proceeding upwards

NORRISTOWN SHALES

Very near the bottom at Weehawken N J

Ischypterus Braunii Newb (Newb U S Geol Surv Mon xiv p 43)
Estheria ovata Lea (N J Geol Surv Rep 1888 pp 26 28 29)
Plants (L P Gratacap Am Naturalist xx p 245)
Footmarks (do p 246)

Likewise very near the bottom at Shady Side N J

Estheria ovata Lea (N J G S Rep 1888 pp 26 9)
Imperfect remains of fishes (do pp 26 9)

About 8500 feet below the top below Norristown and at Ft Washington Pa

Undetermined plants found a few days ago by Prof Heilprin's geological class

About 8000 feet below the top at Greenville four miles and a half easterly from Doylestown Pa

Calamitoid plant (Schizoneura planicostata Font ?) near Doylestown (N Y Ac Sci Trans 1887 p 17)
Calamites (?) undetermined (A P S Proc Vol xxxiii p 7 Feb 1894)

Towards the top at the Rocky Hill quarries a little west of Hartford, Conn

Footmarks (Hitchc Mass Geol Rep 1841 p 466)

Towards the top at Easthampton Mass

Clathropteris platyphylla Brong (Newb Mon xiv p 94)
Brontozoum giganteum E H (Suppl to Ichn p 1)
Mollusk allied to Rudistes Lamk (?) (Hitchc Ich p 6

Towards the top at Wilburtha N J

Estheria (N J G S Rep 1888 p 29)
Plant remains imperfect (do p 9)

Towards the top one mile above Prallsville N J

Estheria (N J Geol Rep 1888 p 30)

Near the top at Newark N J

Lepidodendron Weltheimianum Presl (N J G S Rep 1879 p 26)
Equisetum Meriani (?) (Newb Mon xiv p 86)
Dioonites longifolius Emmons (do p 92)
Clathropteris platyphylla Brong (do p 94)
Palissya Braunii Endl (doubtful) (do pp 13 94)

Near the top at Belleville, N J

Lepidodendron Weltheimianum Presl (N J G S Rep 1879 p 26)
Bone fragment well preserved (Cook N J Geol Rep 1885 p 96)

Near the top at Portland Conn

Dendrophycus triassicus Newb (same as Desorii Lesqx Newb Mon xiv p 9)
Cunichnoides marsupialoideus E H (Ich p 56)
Brontozoum exsertum E H (do p 6)
 validum E H (do p 68)
 Sillimanium E H (do p 69)
Grallator gracillimus E H (do p 74)
Isocampe Moodii E H (do p 120)
Otozoum Moodii E H (do p 1)
Hoplichnus equus E H (do p 135)
Impressions of bones apparently ornithic (W B Rogers Bost Nat Hist Soc Proc Vol vii p 306)

Near the top between Wethersfield and Hartford, Conn

Plectropterna (Sauroidichnites) minitans E H (1841 p 48

Near the top, at Suffield Conn

Alga (Hitchcock Mass Geol Rep 1841 p 453)
Plant possibly a Voltzia (do p 451)
Brontozoum (Ornithoidichnites) giganteum E H (do pp 466 495)

Near the top, on Mt Holyoke Mass

Brontozoum validum E H (Ich p 68)

Near the top, at Montague City one mile south of Turner's Falls Mass

Tridentipes ingens E H (Ich p 83)

Near the top at Turner's Falls Mass

Pachyphyllum simile Newb (Newb Mon xiv p 89)
Pachyphyllum brevifolium (do p 81)
 peregrinum Schimper (Font U S G Surv Mon vi p 108)
Actinopteris quadrifoliata Font (Font Mon vi p 121)
Ischypterus ovatus W C R (Newb Mon xiv p 27)
Ischypterus tenuiceps Ag (do p 83)
 parvus W C R (do pl xiii)
Anomoepus intermedius E H (Sup p)
 curvatus E H (do p 5)
 minimus E H (do p 5)
 gracillimus E H (do p 6)
Anisopus gracilior E H (do p 6)
Brontozoum divaricatum E H (do p 7)
Grallator parallelus E H (do p 7)
 gracilis C H H (do p 8)
Leptonyx lateralis E H (do p 8)
Comptichnus obesus E H (do p 9)
Trihamus elegans E H (do p 9)
Antichiropus hamatus E H (do p 11)
Harpedactylus crassus E H (do p 12)
 gracilior E H (do p 12)
Lunula obscura E H (do p 17)
Bisulcus undulatus E H (do pp 66 84)
Trisulcus laqueatus E H (do p 19)
Grammichnus alpha E H (do p 19)
Ampelichnus sulcatus E H (do p 19) (? Possibly a plant)
Climacodichnus corrugatus E H (do p 20)
Ænigmichnus multiformis E H (do p 20)
Brontozoum giganteum E H Sup p
 approximatum E H (Sup p 21)
Brontozoum minusculum E H (do p 4)
 exsertum E H (do p 67)
 Sillimanium E H (do p 69)
Brontozoum isodactylum E H (do p 70)
Plesiornis mirabilis E H (do p 81)
Anomoepus minor E H (Ich p 59
Anisopus Deweyanus E H (Sup p 64
Anisopus gracilis E H (Ich p ( )
Amblonyx giganteus E H (do p 71
 Lyellianus E H (do p 7)
Grallator cursorius E H (do p 73)
 tenuis E H (do p 73)
 gracillimus E H (do p 74)
 cuneatus E H (do p 5)
Platypterna recta E H (do p 85
 varia E H (do p 86)
 gracillima E H (do p 86)
Tridentipes elegantior E H (do p 90
Corvipes lacertoideus E H (do p 96
Plesiornis quadrupes E H (do p 104)
Typopus abnormis E H (do p 106)
Plectropterna minitans E H (do p 109)
Plectropterna angusta E H (Sup p 67)
 lineans E H (do p 67)
Harpedactylus gracilis E H (Ich p 118)
Xiphopeza triplex E H (do p 118)

Antipus bifidus E H (do p 110)
Chimaera Barratti E H (do p 119)
Isocampe strata E H (do p 120)
Otozoum Moodii E H (do p 125)
Macropterna vulgaris E H (do p 129)
divaricans E H (do p 129)
Shepardia palmipes E H (do p 131)
Lagunculipes latus E H (do p 13_
Selenichnus falcatus E H (do p 133)
breviusculus E H (do p 134
Hoplichnus poledrus E H (do p 136)
Helcura caudata E H (do p 141)
Helcura anguinea E H (do p 141)
Exocampe arcta E H (do p 142)
ornata E H (do, p 143)
Harpagopus dubius E H (do p 148)
Bifurculipes scolopendroideus E H (do p 151)
Hexapodichnus horrens E H (do p 158)
Copeza triremis E H (do p 159)
Trisulcus Marshi E H (do p 160)
intermedius E H (do p 161)
Unisulcus minutus E H (do p 161)
Cunicularius retrahens E H (do p 163)
magnus E H (do p 164)

Near the top, at the Lily Pond Quarry, on R Field s farm, in Gill near Turner's Falls, Mass

Acanthichnus alternans E H (Sup p 14)
anguineus E H (do p 14)
trilinearis E H do p 15)
Copeza propinquata E H (do p 16)
punctata E H (do p 16
Conopsoides curtus E H (do p 16)
Harpepus capillaris E H (do p 16)
Sagittarius alternans E H (do p 16)
Bisulcus undulatus E H (do pp 55 66 76
Brontozoum giganteum E H (do p 24)
approximatum E H (do p 24
Brontozoum minusculum E H (Ich p 60
Brontozoum tuberatum E H (do p 66)
Plesiornis mirabilis E H (do p 68)
Anisopus Deweyanus E H (Sup p 44)
gracilis E H (Ich p 62)
Grallator formosus E H (do p 76)
Argozoum disparidigitatum E H (do p 82)
Argozoum paridigitatum E H (do p 82)
Tridentipes elegantior E H (do p 90)
uncus E H (do p 92)
Gigantitherium caudatum, E H (do p 95)
Gigantitherium minus E H (do p 96)
Hyphepus Fieldi E H (do p 97)
Corvipes lacertoideus E H (do p. 98)
Tarsodactylus caudatus E H (do, p 99)
Apatichnus circumagens E H (do p 100)
Plesiornis quadrupes, E. H (do, p. 103)
Plesiornis pilulatus E H (do p 104
Orthodactylus floriferus E H (do p 114
introvergens E H (do p 114)
Orthodactylus flexiloquus E H (do, p 115)
Arachnichnus dehiscens E H (do p 117)
Macropterna divaricans E H (do p 129)
gracilipes E H (do p 130)
Cheirotheroides pilulatus E H (do p 131)
Saltator caudatus E H (do p 138)
Chelonoides incedens E H (do p 140)
Helcura surgens E H (do p 141)
anguinea E H (do, p 141)
Exocampe arcta E H (do, p 142)
Ptilichnus anomalus E H (do p 145)
typographus E H (do p 146)
pectinatus E H (Sup p 55)
hydrodromus E H (Ich p 146)
Acanthichnus cursorius E H (do p 151)
saltatorius, E H (do p 151)
Acanthichnus tardigradus, E H (do p 151)
Bifurculipes elachistotatus, E H (do, p 154)
Hexapodichnus magnus E H (do, p 158)
Cochlea archimedea, E H (do, p 162)
Halysichnus laqueatus (do p 162)
tardigradus (do, p 163)

Near the top, on Field's farm, in Gill, near Turner's Falls, Mass .

Plant ten feet long (Hitchc Ichn, p 170)
Platypterna digitigrada E H (Ich, p 86)
Apatichnus bellus E H (do p 101)
Plectropterna gracilis E H. (do, p 109).
Orthodactylus linearis, E H (do, p 115)
Stenodactylus curvatus, E H (do, p 117)
Saltator bipedatus, E H (?) (do p 137)
Hamipes didactylus E H (do p 150)
Conopsoides larvalis, E H (do p 152)
Bifurculipes laqueatus, E H (do p 153).
Bifurculipes tuberculatus, E H (do, p 153).

Grammepus erismatus E H (do p 156)
unordinatus E H (do p 156)
Lithographus hieroglyphicus E H (do p 1 6)
Lithographus cruscalis E H (do p 15
[illegible] E H (do p 1 1)
Sphaerapus larvalis E H (do p 1 1

Near the top in Field s orchard in Gill near Turner s Falls Mass

Anisopus gracilis E H (Ich p 62)
Stratipes latus E H (do p 149

Near the top at the quarry near Roswell Field s house in Gill Mass

Anomoepus major E H (Ich p 6)

Probably in the Norristown shales at Southbury Conn

Tree trunk (Hitchcock Rep 1841 p 4)
Catopterus gracilis J H R (Newberry Mon xiv p)

GWYNEDD SHALES

Towards the bottom at Egypt N C

Acrostichides Egyptiacus Emmons (Font Mon vi p 99)

Towards the bottom in the Deep River coal field N C

Acrostichides princeps Schenk (?) (Font Mon vi p 99)
Pariostegus myops Cope (Cope N C Geol Rep 18 5 App p)
Dictyocephalus elegans Leidy (do p 3)
Belodon Carolinensis Emm (do p 84
priscus Leidy (do p 84)

Towards the bottom in the Dan River coal field N C

Cheirolepis Münsteri Schimper (?) (Font Mon vi p 99)
Belodon Leaii Emm (Cope N C Geol Rep 18 5 App p 8)
Estheria ovata Lea (T R Jones Geol Mag vii 1890 p 28)

Towards the bottom in North Carolina

Equisetum Rogersi Schimper (Font Mon vi p 98)
Sphenozamites Rogersianus Font (do p 98)

Towards the bottom (?) in Moore county N C

Belodon Carolinensis Emm (Cope N C Rep 1875 App p 84)
Belodon priscus Leidy (do p 84

Towards the bottom (?) in Montgomery county, N C

Belodon priscus Leidy (Cope N C Rep 1875 App p 84)

Towards the bottom (?) in Anson county, N C

Belodon Carolinensis Emm (Cope N C Rep 1875 App p 84)

Towards the bottom, at Clover Hill, Va

Schizoneura planicostata Rogers (Font Mon vi p 16)
Schizoneura (?) (1 specimen) (do p 16)
Virginiensis Font (do p 16)
Macrotaeniopteris crassinervis Feist (do p 28)
Acrostichides rhombifolius Font (do p 32)
Acrostichides rhombifolius var rarinervis Font (do p 33)
Acrostichides microphyllus Font (do p 34)
Acrostichides densifolius Font (do p 34)
Mertensides distomus Font (do, p 40)
Asterocarpus Virginiensis Font (do p 45)
var obtusiloba Font (do p 46)
Asterocarpus platyrachis Font (do p 47)
penticarpa Font (do p 48)
Cladophlebis ovata Font (do p 51)

Cladophlebis microphylla Font (do p 5
Cladophlebis pseudowhitbiensis Font (do p 52
Lonchopteris Virginiensis Font (do p 54)
Clathropteris platyphylla var expansa Saporta (do p 58
Pseudodanaeopsis reticulata Font (do p 60)
Pseudodanaeopsis nervosa Font (do p 63)
Sagenopteris rhoifolia (?) (do p 63)
Dicranopteris spec (?) (do p 63)
Pterophyllum inaequale Font (do p 65)
Ctenophyllum truncatum Font (do p 69)
Ctenophyllum grandifolium Font (do p 76)
Ctenophyllum giganteum Font (do p [illegible]
Podozamites Emmonsi Font (do p 78)
tenuistriatus Rog (do p 79)
Sphenozamites Rogersianus Font (do p 84
Baiera multifida Font (do p 88)
Undetermined cones (do p 91)

Towards the bottom, at Midlothian, Va

Asterocarpus Virginiensis Font (Font Mon vi p 45)
Pseudodanaeopsis reticulata Font (do p 60
Pterophyllum affine Nathorst (do p 66)
Ctenophyllum taxinum L and H (do p 69)
Podozamites tenuistriatus Rogers (do p 79)

Towards the bottom, at Gowry shaft near Midlothian Va

Acrostichides linnaeaefolius Bunb (Font Mon vi p 28)
Acrostichides rhombifolius Font (do p 32)
Mertensides bullatus Bunb (do p 39)
Zamiostrobus Virginiensis Font (do p 93)

Towards the bottom at Black Heath, Va

Acrostichides linnaeaefolius Bunb (Font Mon vi p 28)

Towards the bottom at Aspinwall shaft, at Manakin near Dover Va

Equisetum Rogersi Schimper (Font Mon vi p 11)
Asterocarpus Virginiensis Font (do p 45)
Pecopteris rarinervis Font (do p 49)
Cladophlebis subfalcata Font (do p 49)
Lonchopteris Virginiensis Font (do p 51)

Towards the bottom, at Carbon Hill, Va

Schizoneura planicostata Rog (Font Mon vi p 16)
Acrostichides rhombifolius Font (do p 32)
Mertensides bullatus Bunb (do, p 39)
Asterocarpus Virginiensis, Font (do p 45)
Pecopteris rarinervis Font (do p 49)
Cladophlebis auriculata Font (do p 50)
Pseudodanaeopsis reticulata Font (do p 60)
Ctenophyllum Braunianum var α, Goepp (do p 78)
Podozamites tenuistriatus Rog (do p 79)
Baiera multifida Font (do p 88)

Towards the bottom, at Deep Run, Va

Podozamites tenuistriatus Rog (Font, Mon vi p 79)

Towards the bottom, in the Richmond basin, Va,

Catopterus gracilis, J H R (Newb Mon. xiv p 11)
Dictyopyge macrura Egt (do p 11)
Ischypterus ovatus W C R (do p 11)

Towards the bottom, in the Farmville, Cumberland county, Va, area

Equisetum Rogersi Schimper (Font. Mon vi, p 12)
Pterophyllum decussatum, Emmons (do, p 67)
Podozamites tenuistriatus Rog (do p. 79)
Cheirolepis Münsteri, Schimper (do p. 89)
Bambusium (?) (do, p 90)

ERRATA.

Please insert the two following lists of fossils at the first break on page 209:

Towards the bottom, about two miles north of west of Emigsville, York County, Pa.

Belodon Priscus, Leidy (Cope, A P S Proc , 1886, Vol xxiii, p 403)
Belodon Carolinensis, Emmons (do ,p. 403)
Palæosaurus Fraserianus, Cope (do., p 404).
Suchoprion cyphodon, Cope (do , p. 404)
" aulacodus, Cope (do , p 404)
Clepsysaurus Veatleianus, Cope (do , p 404)
Palæoctonus appalachianus Cope (do , p 404)
Thecodontosaurus gibbidens, Cope (do., p 404)

Towards the bottom, four miles "eastward" from the Goldsboro fossil footprints, York Co., Pa.:

Ramulus rugosus, Wanner (Pa Geol Rep , 1887, p. 27)

On page 212, eight lines from the top, instead of "Reading" read *Pennsylvania*.

On page 214, seven lines from the top, instead of "bottom" read *top*.

Towards the bottom in the Hanover county Va area

Equisetum Rogersi Schimper Font Mon vi p 12)

Macrotaeniopteris magnifolia Schimper (do p 0)

Cladophlebis rotundiloba Font (do p [illegible])

Cycadites tenuinervis Font (do p [illegible])

Near the bottom near Durham Conn

Baiera Münsteriana Ung Newb Mon xiv p 84)

Schizoneura planicostata Rogers (do p 87)

Pachyphyllum brevifolium Newb (Newb Mon xiv p 89)

Otozamites latior Saporta (do p 90)

brevifolius F Br (do p 91)

Cycadinocarpus chapini Newb (do p [illegible])

Loperia simplex Newb (do p 93)

Clathropteris platyphylla Brong (do p 94)

Ischypterus macropterus Newb (do p [illegible])

Ischypterus tenuiceps Ag (do p 94

minutus Newb (do p 46

Catopterus Redfieldi Egerton (do p [illegible]

gracilis J H Red (do p [illegible]

minor Newb (do p 7

ornatus Newb (do [illegible]

anguilliformis W C Red (do p [illegible]

Ptycholepis Marshii Newb (do p [illegible]

Diplurus longicaudatus Newb (do p 4

Near the bottom at Middlefield Conn

Ischypterus ovatus W C R (Newb Mon xiv p [illegible])

Ischypterus fultus Ag (do p 34)

Brontozoum giganteum E H (Suppl Ichn p 21

Plesiornis aequalipes E H (do p 10

Typopus gracilis E H (do p 1)

Near the bottom at Middletown (west of the village) Conn

Fucoid undetermined (Hitchc 1841 p 4 3)

Catopterus gracilis J H R (Newb Mon xiv p [illegible])

Catopterus anguilliformis W C R ( ) (do p 50)

Anisopus Deweyanus E H (Ich p 61)

gracilis E H (do p [illegible]

Chimaera Barratti E H ( ) (do p 11)

Cunicularius retrahens E H (do p 103)

Near the bottom at Westfield Conn

Ischypterus ovatus W C R (Newb Mon xiv p 2)

Ischypterus fultus Ag (do p 34)

Ischypterus parvus W C R (?) (do p 4)

Catopterus anguilliformis W C R ( ) (do p 59)

Near the bottom at the Cove in Wethersfield Conn

Fucoid undetermined (see Hitchcock Mass Geol Rep 1841 p 460)

Plants undetermined (do p 461)

Coprolites (?) (do p 461)

Brontozoum giganteum E H (Suppl p 24)

Brontozoum minusculum E H (do p 21)

Brontozoum divaricatum E H (C H H Bost Nat. Hist Soc xxiv p 121)

Brontozoum Sillimanium E H (do p 121)

Argozoum disparidigitatum E H (Ich p 82)

Argozoum paridigitatum E H (do p 82)

Grallator cuneatus (C H H Bost N H S, xxiv p 121)

Grallator tenuis (do p 121)

Corvipes lacertoideus E H (do p 12)

Anomoepus curvatus (do p 1 1)

Platypterna Deaniana E H (Ich p 83)

tenuis E H (do p 84)

delicatula E H (do p 84)

Ornithopus gallinaceus E H (do p 87)

gracilior E H (do p 88)

Tridentipes insignis E H (do p [illegible])

Plectropterna minitans (do p 100)

elegans E H (C H H B N H S xxiv p 12)

Plectropterna gracilis E H (do p 122)

Plectropterna lineans E H (Suppl p 71)

Plesiornis giganteus C H H (B N H S xxiv p 122)

Plesiornis aequalipes E H (do p 122)

n sp (do p 122)

Trihamus elegans E H (do p 122)

Trihamus magnus C H H (do p 122)
Triaenopus leptodactylus E H (Ichn p 111)
Harpedactylus n sp (C H H B N H S xxiv p 122)
Typopus abnormis E H (do p 122)
Comptichnus n sp (do p 1[illegible])
Ancyropus heteroclitus E H (Ich p 133)
Acanthichnus cursorius, E H (do p 139)
Acanthichnus cursorius var trilinearis E H (do p 133)
Acanthichnus cursorius var alatus E H (do p 139)
Conopsoides larvalis E H (Ich p 152)
Unisulcus minutus (C H H B N H S xxiv p 122)
Bisulcus (do p 122)
Trisulcus (do p 122)
Cochlichnus, 2 sp (do p 122)
Sagittarius and other footmarks (do p 122)

Near the bottom at Mittineaque Falls, in West Springfield, Mass

Footmarks (Hitchcock Mass Geol Rep 1841 p 460)

Near the bottom, at West Springfield, Mass

Coprolite ( ) (Hitchcock Mass Geol Rep 1841 p 461)

Near the bottom, in southeastern Northampton Mass

Anisopus gracilis E H (Ich p 62)
Brontozoum minusculum E H (do p 66)
Brontozoum exsertum E H (do p 67)
validum E H (do p 68)
Sillimanium E H (do p 69)
Brontozoum isodactylum E H (do p 70)
Brontozoum giganteum E H (Sup p 21)
approximatum E H (do p 24)
Tridentipes ingens E H (Ich p 89)
insignis E H (do p 91)
Palamopus Clarki E H (do p 12)

Near the bottom in South Hadley, Mass

Anisopus gracilis, E H (Ich p 62)
Brontozoum Sillimanium E H (do p 69)
isodactylum E H (do p 70)
Grallator cursorius E H (do p 73)
Grallator tenuis E H (do p 73)
gracillimus E H (do p 71)
Batrachoides nidificans E H (do p 123)

Near the bottom in the north part of South Hadley, Mass

Anisopus Deweyanus E H (Sup p 45)
Brontozoum giganteum E H (Sup p 24)
Grallator cuneatus E H (Ich p 75)
Batrachoides nidificans (do p 123)
Otozoum Moodii E H (do p 125)

Near the bottom, at Whitmore's Ferry, in Sunderland, Mass

Plants (Hitchc Mass Geol Rep, 1841, p 450)
Fishes (do p 458)
Schizoneura planicostata, Rog (Newb, Mon xiv p 12)
Clathropteris platyphylla Brong (do p 94)
Pachyphyllum simile Newb (do p xxii)
Ischypterus ovatus W C R (do, p 27)
" Marshii, W C R (do p 29)
" Agassizii W C R (do p 30)
" parvus, W C R (do p 45)
" latus J H R (do, p 46)
tenuiceps Ag (do, Pl v, vii)

Near the bottom, at Marsh's quarry, in the southwest part of Montague, Mass

Anticheiropus pilulatus E H (Sup, p 10)
Tridentipes elegans E H (do p 90)
Tridentipes insignis, E H (do, p 91)
Chimaera Barattii, E H (?) (do, p 119)

Near the bottom, at two miles south of Turner's Falls, in Montague, Mass.

Tridentipes elegans E H (Ich p 90)

Near the bottom, in Montague, Mass

Clathropteris, obscura (Font, Mon vi, p 86)

Near the bottom, in the north part of Montague Mass

Tridentipes elegans E H (Ich p 90)

Near the bottom at the Horse Race in Gill Mass

Brontozoum giganteum E H (Sup p 21)
approximatum E H (Ich p 24)
Argozoum paridigitatum E H (Ich p 8[illegible])
Ornithopus gallinaceus E H (Ich p 8[illegible])
Tridentipes ingens E H (do p [illegible])
elegans E H (do p [illegible])
insignis E H (do p 1[illegible])
H[illegible]ichnus [illegible] (Ich p [illegible])

Near the bottom in Gill Mass

Dictyophyllum or Camptopteris (Font Mon vi p 9)

Somewhere near the bottom at Springfield Mass

Anchisaurus polyzelus (Hitchcock Supp Ichn 1865 p 39 and Marsh Am Jour Sci xxxvii p 332 1889)
Coprolite ( ) (Hitchc Mass Geol Rep 1841 p 411)

Somewhere near the bottom one mile south of Chicopee, on the road to Springfield Mass

Ancyropus (Sauroidichnites) heteroclitus E H (1841 p 479)
Plectropterna (Sauroidichnites) minitans E H (1841 p 48
Polemarchus gigas E H (Ich p 108)

Somewhere near the bottom at Chicopee Mass

Plant resembling Lemania (Hitchc Rep 1841 p 4[illegible]0)

Somewhere near the bottom at South Hadley Falls Mass

Plant undetermined (Hitchc Mass Rep 1841 p 452)
Harpagopus dubius E H ( ) (Ich p 148)
Fishes (Newb Mon xiv p [illegible]1)

Towards the bottom at Chicopee Falls Mass

Plant perhaps a Fucoid (Hitchc Mass Rep 1841 p 453)
Footmarks (do p 466)
Pycnodont fish tooth (do p 460)
Acentrophorus Chicopensis Newb (Newb Mon xiv p [illegible]0)
Argozoum Redfieldianum E H (Ich p 82)
Argozoum disparidigitatum E H (Ich p 82)
Ornithopus gallinaceus E H (do p 87)
Polemarchus gigas E H (do p 108)

Towards the bottom at Ellingtons N C

Laccopteris Münsteri Schenk (Font Mon vi p 102)
Laccopteris elegans Presl (do p 102)
Lonchopteris oblongus Emmons (do p 103)
Sagenopteris rhoifolia (do p 104)
Acrostichides rhombifolius Font (do p 105)
Palissya diffusa Emmons (do p 107)
Cheirolepis Munsteri Schimper (do p 108)
Equisetum Rogersi Schimper (do p 109)
Podozamites Emmonsi Font (do p 111)
Pterophyllum decussatum Emmons (do p 111)
Pseudodanaeopsis reticulata Font (do p 116)
Ctenophyllum type of imbricatum (do p 115)

Below the middle, at Klinesville, N J

Lamellibranch undetermined (N J Geol Rep 1888 p 29)
Cypris (do p 30)
Estheria (do p 30)

Near the middle, at Manchester, Conn

Anchisaurus major Marsh (Am Jour Sci 1889 xxxvii p 331)

About the middle, at Haywood, N C

Cladophlebis obtusiloba Andrae (?) (Font, Mon vi, p 105)
Ctenophyllum Braunianum var β Goepp (do, p 112)

Perhaps about the middle, at five miles north of Haywood, N C

Baiera multifida Font (Font Mon vi p 118)

Perhaps about the middle, at House's quarry on the Haw river, N C

Ctenophyllum Emmonsi Font (Font, Mon vi p 113)
Ctenophyllum lineare Font (do p 114)
Pterophyllum spatulatum Font (do p 114)
Zamiostrobus Emmonsi Font (?) (do p 117)

At about 1500 feet below the top at the south entrance of the Reading railroad tunnel, near Phœnixville Pa

Plants (H C Lewis Science 1891 Vol III p 295)
Unio 2 species (do p 295)
Marine lamellibranchs 3 species (do p 295)
Ganoid fish (do p 295)
Saurian (?) (do p 295)

At about 1000 feet below the top, in the Reading railroad tunnel, near Phœnixville, Pa

Estheria Hindei T Rup Jones (Geol Mag 1891 viii p 51)
Estheria Lewisii T Rup Jones Red S S of Bucks county Pa (do 1890 vii p 395)
Ganoid fishes (Leidy A N S Proc 1856, Apr 5)
Clepsysaurus (?) teeth (do do) (These are Belodon teeth according to Cope)
Eurydorus serridens (do do)
Compsosaurus (?) (do do)
Eupelor durus (Cope do 1866 p 249 and A P S Trans 1868 xiv p 25)
Belodon Carolinensis Emm (Cope A P S Proc 1886 xxiii p 403)
Belodon lepturus Cope (A P S Trans 1868 xiv p 59)
Rhabdopelix longispinis Cope (?) (do p 174)
Dicynodon rosmarinus (do 232)
Batrachian tracks (Cope do p 242)
Coprolites (Wheatley A N S Proc 1859 p 110)
Limulus (?) (do p 110)
Equisetum columnare Brg (do p 110)
Pterozamites longifolius Emm (do p 110)
Gymnocaulus alternatus Emm (do p 110)
Fir Cones (Lea A J S 1856 xxii p 123)
Calamites punctata (do p 123)
Dictyocaulus striatus (do p 123)
Estheria ovata Lea (Wheatley A N S Proc, 1861 Vol xxxii p 44)
Estheria parva Lea (do p 43)
Cypris 2 species (do p 43)
Myacites Pennsylvanicus Conrad (A N S Proc 1857 p 86)
Radiolepis speciosus, Emm (Lea do, 1857 July 7)
Centemodon sulcatus Lea (do 1856, Mar p 77)
Chelichnus Wymanianus Lea (do p 77)
Catopterus gracilis Redf (Wheatley, A J S 1851 p 41)

At about 1000 feet below the top, near Yerkes Station, Montgomery county, Pa

Radiolepis elegans Emm (Leidy A N S Proc, 1876, May 9 p 81)

At about 1000 feet below the top, at the Gwynedd tunnel, Montgomery county, Pa

Cypris (Leidy, Ac Nat Sci Proc, 1857, June 16)
Batrachian (?) bones and teeth (do, do)
Radiolepis speciosus Emm (Lea do, 1857, July 7)
Eurydorus serridens (?) (Leidy, do, 1859, Apr 5)
Rhabdopelix longispinis, Cope (A P S Trans 1868 xiv, p 174)
Turseodus acutus, Leidy (A N S Proc 1857, June, p 167)

Towards the top, "2000 feet or more above the coal measures" at Lockville, Chatham county N C

Sagenopteris rhoifolia (Font , Mon xii p 104)
Palissya Braunii Endl (do p 107)
Cheirolepis Münsteri Schimper (do p 108)
Cycadites Roemeri Schenk (?) (do p 109)
Cycadites longifolius Emm (?) (do p 110)
Pterophyllum pectinatum Emm (do p 112)
Zamiostrobus Emmonsi Font (?) (do p 117)
Otozamites Carolinensis Font (do p 117)
Araucaria (?) (do p 118)
Araucarites Carolinensis Font (do p 119)

Towards the top at Ketch's mills in the east part of East Windsor Conn

Bones undetermined (Hitchc Mass Geol Rep 1841 p 504)

Towards the top, at Ellington (Ct)

Bones undetermined (Hitchc Mass Geol Rep 1841 p 504)

Perhaps towards the top at Amherst Mass

Fishes (Newb Mon xiv p 21)

Towards the top, at Washington's Crossing, N J

Estheria (N J Geol Rep 1888 p 90)
Fishes (do p 80)

Very near the top, at Tumble Station N J

Footmarks (Nason N J Geol Rep 1889 p 0)

LANSDALE SHALES

Towards the bottom, at Little Falls and Pleasantdale, N J

Plants abundant (Nason N J Geol Rep 1888 p 23)

Towards the bottom, near Feltville, N J

Cypris (?) (Nason N J Geol Rep 1888 p 22)

Towards the bottom, at Fields' copper mine near Warrenville, and near Plainfield N J

Estheria (Nason N J Geol Rep 1888 p 80)
Fishes (do pp 29 30)

Towards the bottom, near Washingtonville, N J

Plants (Nason N J Geol Rep 1888 p 27)

Towards the bottom, near Martinsville, N J

Tree trunks and ferns (Nason N J Geol Rep 1888 p 27)

Towards the bottom, near Pluckamin, N J

Plants (Nason N J Geol Rep 1888 p 23)

About the middle, near New Providence, N J

Plants (Nason N J Geol Rep , 1888 p 23)

About the middle, near Whitehall, N J

Tridentipes ingens, E H (C H H , Bost Soc N Hist , xxiv p 122)
Brontozoum giganteum, C H H (do , p 122)
Brontozoum minusculum, E H (do , p 122)
Brontozoum Sillimanium F H (do p 122)
Grallator formosus E H (do p 122)
Grallator parallelus F H (do p 122)
' cursorius E H (do p 122)
Anomoepus intermedius, E H (do , p 122)

Apatichnus crassus C H H (do p 1[illegible])
Anisopus gracilis E H (do p 1[illegible]2)
Brontozoum isodactylum (Cook N J Geol Rep 1885 p 96)
Brontozoum divaricatum E H (do p 96)

Towards the top at Pompton furnace N J

Ischypterus Agassizii W C R (Newb Mon xiv p 30)

Perhaps towards the bottom one mile south of Goldsboro York county Pa

Ramulus rugosus Wanner (A Wanner Pa Geol Rep 1887 p [illegible]7)
Algæ (do p 21)
Anomœpus gracillimus C H H (Bost Nat Hist Soc Proc xxiv p 1[illegible])
Brontozoum Sillimanium E H (do p 123)
Anisichnus gracilis E H (do p 123)

PERKASIE SHALES

Near the bottom at Smith Clark s quarry near Milford N J

Palæophycus limaciformis H C Lewis (A N S Proc Nov 1880 p 98)
Schizoneura planicostata Rog (Newb Mon xiv p 11)
Equisetum Rogersi Schimper (do p 85)
Cheirolepis Munsteri Schimper (do p 83)
Clathropteris platyphylla Brg (do p 91
Grallator parallelus E H (C H H Bost Nat Hist Soc xxiv p 122)
Grallator cuneatus Barratt (do p 122)
gracilis C H H (do 122)
Chimærichnus ingens C H H (do p 122)
Polemarchus gigas L H (do p 122)
Argozoum disparidigitatum E H do p 122
Otozoum parvum C H H (do p 122)
Unisulcus magnus C H H (do p 122)
Sagittarius (do p 122
Brontozoum isodactylum E H ([illegible] Ac Nat Sci Proc 1889 p 32)
Grallator tenuis E H (do p 8)
Anomœpus minor E H (do p 87)
Harpagopus dubius E H (do p 87)
Unisulcus marshi E H (do p 82)
minutus E H (do p 32)

Near the bottom at Boonton N J

Ischypterus ovatus W C R (Newb Mon xiv p 7)
Ischypterus Agassizii W C R (do p 30)
tenuiceps Ag (do p 34)
fultus Ag (do p 34)
robustus Newb (do p 37)
elegans, Newb (do p 37)
alatus Newb (do p 38)
modestus Newb (do p 39)
lenticularis Newb (do p 39)
lineatus Newb (do p 41)
Ischypterus macropterus W C R (do Pl xii)
Ischypterus parvus W C R (?) (do p 45)
Ischypterus gigas Newb (do Pl xiv)
Catopterus parvulus W C R (do p 61)
gracilis J H R (do p 55)
Diplurus longicaudatus Newb (do p 74)
Brontozoum approximatum C H H (Bost Nat Hist Soc xxiv p 123)
Grallator formosus E H (do. p. 123)

Towards the bottom, at New Vernon N J

Footmarks imperfect (Cook N J Geol Rep 1885 p 96)

NORRISTOWN SHALES

About 5000 feet above the bottom in Upper Milford township, Lehigh county, Pa

Clepsysaurus Pennsylvanicus Lea (Lea A N S Jour 1853 p 185)

These lists probably show satisfactorily that there is no serious paleontological obstacle to accepting the views here set forth in regard to the New Red; certainly none to compare in seriousness with the obstacles that were boldly overridden repeatedly in making the Portland and Newark fossils Triassic.

Although the account just given puts quite another face upon the New Red with the unquestionably great thickness in Pennsylvania, and the partly conjectural, but quite harmoniously corresponding, condition of the beds in other States, yet it is clear that what is most extraordinary about the present views, so far as they are speculative, is that, for New Red speculations, they are so little extraordinary, so free from extravagance, so natural, probable and simple, yet so fully capable of explaining all the observed facts. It is seen that, although the New Red beds do not everywhere exist in the same completeness as in Montgomery county, yet that certain portions are pretty fully represented in distant States, the lower third in Connecticut, the lower half in Northeastern New Jersey, and the lower portions and upper portions in separate basins in Virginia. It is further plain that almost all, if not quite all, the fossils from which the Rhaetic, or Triassic, or Jurassic age of our New Red has been inferred, come from the Gwynedd shales alone, and that the few fossils from other parts of the whole New Red series have either been useless as indications of age or have been flatly disregarded. Hence it is not improbable that the Norristown shales, with the great calamite near Doylestown, the apparent Lepidodendron at Newark and Belleville, and the Palæophycus at Portland, may after all prove to be at least as old as the Permian. It seems, indeed, highly probable that the well ascertained great thickness of 27,000 feet in Montgomery county should represent more than one limited paleontological period, and not only that it should include the Permian, but that the very extensive upper third of that space, hitherto almost devoid of reported fossils, should turn out to be much newer than the Triassic. Those upper beds have also shown here and there imperfect fossil traces, and as there are occasional beds of green shales among the predominant red ones, there is reason to hope that more abundant and perfect fossils may some day be found.

As for the trap, it seems impossible to doubt any longer that all the conformable trap sheets are overflows contemporaneous with the sedimentary beds, and not subsequent intrusions

It is furthermore at any rate evident that thoroughly geological methods, as distinguished from purely paleontological ones, are of great importance in working out the geology, that is, the structure, the cross-sections, the columnar section and the outcrops of any region, but especially of one where fossils are scarce, and that the topography is extremely useful as an aid to understanding the geology.

Remarks on Mr Lyman's Paper.

By Dr Persifor Frazer.

The paper of Mr Lyman is astonishing in the fact that it does not mention the seven years' work by the Second Geological Survey of Pennsylvania on the New Red in York, Adams, Cumberland and Lancaster counties, although the method he advocates was the very method there adopted, viz, the careful topographical and geographical plotting of the region and the accurate location of every dip. There is neither justice nor expediency in ignoring years of work by a colleague, especially when one occupies a quasi directorship of the Survey under whose auspices the work was done

From the section across the counties of York and Adams, from the town of York to Dillsburg, made in 1875, careful descriptions of the successive beds were made, as well as notes of their dip, and from these data a column was constructed for correlation with the columns of the Permian, Triassic and Jurassic in England and in Germany In a paper contributed to Vol v, *Trans American Institute of Mining Engineers*, founded on the work done in 1874 in Southeast Pennsylvania, it was suggested that the basal conglomerate of the New Red might find its analogue in the magnesian limestone of England and the Zechstein of Germany, both of which represent the top of the Permian in the respective countries.

The thickness of the strata calculated by H D Rogers from the Yardleyville-New Hope-Attleboro' section, and confirmed by the writer, was 51,800 feet, or 15 75 kilometers, but neither Prof Rogers nor the speaker believed that this represented the actual state of the case It was stated that the New Red seemed to extend from some point in the Permian, at least, to the base of the Lias, including all the rocks attributed to the Trias and the beds below it, except the lower Rothliegendes of the German scale.

It is added, in the same paper, as a matter of frequent remark that all the beds of the "New Red" are not red. On the contrary, perhaps one-half of the whole series presents to the eye a lead-gray and drab color. It was suggested as possible that the black calcareous slates of Phœnixville might represent a lower horizon than the coal-bearing belt (near Ewingsville?) referred to in the catalogue of specimens of Report C, of York county, for 1874.

With reference to the subordinate position which paleontological should bear to stratigraphical evidence, the case would seem to be not quite fairly stated. If there were everywhere a complete column of strata of which the mutual relations were unmistakable, then paleontological evidence would be forced to conform itself to the column as best it might. But the case is like that of the relation between the astronomical transit and the compass, or the level and the barometer—the latter is invaluable where the former cannot be employed. For coördination of series in two distant places between which there is no stratigraphical connection, paleontological evidence is the only evidence available

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On the Lungs of the Ophidia.

By Prof. E. D Cope

(Read before the American Philosophical Society, May 18, 1894)

The condition of knowledge as to the characters of the lungs of snakes was stated by Stannius, in 1856,* as follows "The detailed accounts as to the single or double character of the lungs leave much to be desired Among Ophidia Angiostomata there possess a single sack, Rhinophis and all Typhlopidæ which have been examined , as to the Tortricidæ [Ilysiidæ], there are apparently species with two lungs (*T xenopeltis*) [= *Xenopeltis unicolor*], and others with a single lung (*T scytale*) [*Ilysia scytale*] Among Eurystomata, all the Peropoda (Boa, Python, Eryx) possess apparently two lungs The Calamarina that have been investigated have one lung Among Colubrina and Glyphodonta, there are great variations. All the Coronellæ of Schlegel possess, according to Schlegel, a single lung I find the lung single in *Rhachiodon scaber* [*Dasypeltis*]. *Tropidonotus natrix* [*Natrix vulgaris*] has a very small rudiment of a second lung. *Coluber* [*Spilotes*] *variabilis* possesses, according to Schlegel, the rudiment of a second lung According to the statement of Meckel, this rudiment is common in Coluber. The Xenodons have, according to Schlegel, a single lung (*X. severus* and *X rhabdocephalus*) In Heterodon I find a rudimental second lung The Lycodons, according to Schlegel, possess a single lung , as also do Psammophis and Homalopsis In *Dendrophis colubrina* Schlegel found the rudiment of the second lung. In Dipsas, according to Schlegel, there are variations; but he states that *D. multimaculata*, *D lævis* and *D annulata* [*Sibon annulatum*], have but one lung The Achrochordina have but one lung. Among Hydrophidæ I found in three species of Hydrophis the lung sack simple. Meckel states that Platurus has a very small rudiment of a second lung. Among the remaining poisonous snakes there is an insignificant rudiment of the second lung in the Elapina and Crotalina, while the Viperina possess an entirely simple lung "

The absence of tangible external characters which furnish indications of affinity in the Ophidia is well known The important characters to be found in the skeleton were mostly pointed out by Müller, and Duméril and Bibron examined and utilized the characters of the dentition. The characters derived from the skeleton define only the larger divisions while those derived from the teeth are not sufficiently numerous and important, with some exceptions, to indicate all of the affinities of the genera. I think I have added materially to the means at our disposal for classifying the Ophidia, by a study of the hemipenis.* The criteria will however not be sufficient until the entire anatomy is worked out, and in the present paper I add what may be found by a study of the lungs. It seemed probable to me that an organ which presents so much variation, as above stated by Stannius, must furnish some important clues. My examinations embraced about one hundred and fifty species, which represent nearly all the leading types. The results are presented in the following pages. It will be seen that they correct the statements of Schlegel and Stannius in a number of important respects.

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* *Zootomie der Amphibien*, p. 108.

The snakes with rudimental posterior limbs (Peropoda), show in the character of their lungs, what they show in the rudimental limbs themselves, and in the hemipenis, the nearest relationships to the Lacertilia. They possess, with an exception to be noted later, two well developed lungs, one of which is larger than the other. The smaller lung lies to the right side and ventrally, while the larger one lies to the left side and dorsally. In some species the dorsal and ventral relation is more pronounced than in others. In the Colubroidea the right or ventral lung is generally present, but of very much reduced proportions, the usual size being from two to five millimeters in length. It is connected with the other lung by a foramen which perforates the tracheal cartilage at a point a little beyond the apex of the heart, and opposite to the proximal part of the dorsal lung. It is sometimes connected to the dorsal lung by a short tube, in which cartilaginous half rings are seen in but two of the genera examined, viz., Heterodon and Conophis. The lumen of the rudimental lung may be lined by the same reticulate structure as is seen in the dorsal lung, or its walls may be smooth. In some Colubroidea the rudimental lung is absent, but such species are relatively few.

The dorsal lung may present proximally alongside of the trachea an auricle or pocket, and this is so developed in the genus Heterodon as to reach to the head, without communication with the trachea, other than that furnished by the normal portion of the lung. In the Solenoglypha, without exception, this extension of the dorsal lung is present, and extends to the head, and its lumen is continuous with the trachea throughout its length. The same structure exists in the genera Hydrus and Hydrophis; and also in the peropodous genus Ungualia, which differs besides from other Peropoda in having but one posttracheal lung. Finally the tracheal lung, as I shall call it, is distinct from the true lung in Platurus and in Chersydrus. In the former of these genera the trachea is not separate from the lumen; while in Chersydrus it is distinct. It, however, communicates with the cells of which the lung consists in this genus by a series of regularly placed foramina on each side. There is no lumen in the tracheal lung in

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* *American Naturalist*, 1893, p. 477.

Chersydrus. In Typhlops we have a still further modification of the tracheal lung. It is without lumen, and is composed of coarse cells of different sizes These have no communication with the trachea or lung that I can discover, nor any efferent orifice It has occurred to me that this structure, which extends from the heart to the throat, may not be a pulmonary organ.

I have referred to the dorsal and ventral positions of the two lungs The rudimental lung is to the right of the dorsal lung in the Colubroidea, but in the Ilysiidæ it is to the left It is quite questionable which lung this rudiment in this family really represents. In the Typhlopidæ, the single lung is on the right side and extends from the heart to the liver It has the position of the rudimental lung of the Colubroidea, and may represent it I cannot decide this question without further material. In Glauconia there is but one true lung, and this is ventral in position, and originates to the right of the heart, so that in this genus also it may represent the rudimental lung of the Colubroidea. There is here no tracheal lung or organ *

I now give a synopsis of the characters observed in the species examined

CATODONTA.

Glauconia dulcis B. and G A single elongate right lung, no rudiment of left lung. No tracheal lung

EPANODONTA

Typhlops liberiensis Hallow.; *T reticulatus* L A right lung which is not elongate; no rudimental left lung A cellular body surrounding the trachea, and extending from the heart to the throat, without lumen or connection with the trachea or lung

The presence of the tracheal lung (?) and the freedom of the maxillary bone are points of resemblance to the Solenoglypha !

TORTRICINA.

Ilysiidæ.

Two lungs, the ventral one to the left side of the middle line, rudimental, but lined with pulmonary tissue like the other lung, and less reduced than in the Colubroidea.

Cylindrophis maculata L. The right lung extends only to the liver

Ilysia scytale L. The right lung is larger.

Rhinophidæ.

Rhinophis oxyrhynchus Schn. One large left lung and very small (8 mm.) right lung; no tracheal lung. Contrary to the statement of Stannius above quoted, as in Colubroidea generally.

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* Cf. Peters, *Reise nach Mossambique*, iii, p. 100, Pl. xiva, 1882

ASINEA

PEROPODA

I. Two well-developed lungs of unequal size, no tracheal lung.

Pythonidæ.

Python regius Shaw, *P. molurus* Linn., *P. spilotes* Lacep.; *Loxocemus bicolor* Cope.

Boidæ

Xiphosoma caninum L., *Epicrates cenchria* L., *Chilabothrus inornatus* Rein., *Boa constrictor* L., *Eunectes murinus* L., *Eryx johnii* Russ.

Charinidæ

Besides the absence of coronoid and supra and postorbital bones, this family differs from the Boidæ in the fusion of the nasal bones into a single plate. *Charina bottæ* Blv.

II. One lung without rudiment of a second, a tracheal lung extending from true lung, with which it is continuous, to throat.

Ungualiidæ.

Ungualia maculata Bibr., *U. melanura* Gray.

COLUBROIDEA.

I. Two well-developed but unequal functional lungs.

Xenopeltidæ.

Xenopeltis unicolor, Reinwt.

II. One functional lung only, the right rudimental lung sometimes possibly with limited function.

Colubridæ.

Lycodontinæ.

Lycodon aulicus L., *Boaodon infernalis* Gthr.; *Uriechis microlepidotus* Pet.; *Stenorhina ventralis* D. and B.

Colubrinæ.

Elapops modestus Gthr.*; *Coronella girundica* Daud.; *Dianodon semicarinatus* Cope. *Ficimia olivacea* Gray; *Salvadora bairdii* Jan.; *Pityophis sayi* Holbr.; *Epiglottophis pleurostictus* D. and B.; *Spilotes corais* Cuv.; *S. pullatus* L.; *Coluber quadrilineatus* Pallas; *C. obsoletus* Say, *C. quadrivittatus* Holbr.; *Bascanium constrictor* L.; *B. flagellum* Catesby; *B. mentovarium* D. and B.; *Zamenis atrovirens* Shaw; *Z. korros* L.;

* Position uncertain, perhaps a Lycodontine.

Cyclophis æstivus L., *Drymobius pantherinus* Merr., *D. boddaertii* Seetz., *D. margaritiferus* Schl., *Crossanthera melanotropis* Cope, *Herpetodryas carinatus* L.; *Leptophis præstans* Cope, *L. mexicanus* D. and B., *L. smaragdinus* Boie; *Dendrophis picta* L., *Dasypeltis palmarum* Leach.

Dipsadinæ

Dipsas blandingii Hallow., *Himantodes gemmistratus* Cope, *Rhinobothyrum lentiginosum* Scop., *Trimorphodon biscutatus* D. and B., *Sibon septentrionale* Kenn., *Malpolon lacertinum* Wagl.; *Cladophis kirtlandii* Hall., *Dryophis fulgida* Daud., *Passerita mycterizans* L.

Chrysopeleinæ

Chrysopelea ornata Shaw.

Xenodontinæ

Calostoma badium D. and B., *Farancia abacura* Holbr., *Abastor erythrogrammus* Daud., *Opheomorphus fuscus* Cope, *Helicops angulatus* Linn., *H. baliogaster* Cope, *Dromicus parvifrons* Cope, *Halsophis leucomelas* D. and B., *Xenodon rhabdocephalus* Wied, *X. angustirostris* Peters, *Lystrophis dorbignyi* D. and B., *Heterodon nasicus* B. and G., *H. platyrhinus* Latr., *Hypsirhynchus ferox* Gthr., *Uromacer oxyrhynchus* D. and B., *U. catesbyi* D. B. Right lung larger in *Uromacer*.

Scytalinæ

Hydrocalamus quinquevittatus D. and B., *Erythrolamprus venustissimus* L.; *E. fissidens* Gthr., *Oxyrrhopus plumbeus* L., *O. fitzingerii* Jan., *Conophis pulcher* Cope, *C. sumichrastii* Cope, *Manolepis nasutus* Cope, *Jaltris dorsalis* Gthr., *Philodryas viridissimus* L., *P. olfersii* Licht.

Natricinæ

Generally a proximal auricle or pocket. *Eutænia proxima* Say, *E. sirtalis* L., s. s. *sirtalis*, *obscura* and *parietalis*; *Natrix fasciata* L., *N. rhombifera* Hallow., *N. taxispilota* Holbr.

Appendix to Colubridæ.

In the African *Thrasops flavigularis* Hallow. the right (rudimental) lung measures 5 mm. The trachea is enormously expanded transversely, simulating a tracheal lung, but its inferior wall contains the tracheal cartilages which extend its entire width, and it contains no cells or trabeculæ. An artery with lateral branches extends its entire length, which is from the posttracheal lung to the throat. This character distinguishes this genus from Leptophis.

In the following species I found no trace of the right lung.

Colubrinæ. *Rhinochilus lecontei* B. and G.; *Cemophora coccinea* Blum.; *Ophibolus doliatus* L.; *O. getulus* L.; *Pityophis melanoleucus* Daud.

Xenodontinæ. *Halsophis angulifer* D. and B.; *H. vudii* Cope.

Leptognathinæ. I propose this subfamily as distinct from the Xenodontinæ, on account of the presence of a large tracheal lung which is continuous with the normal lung, and with the trachea, and extends to the throat. *Leptognathus nebulatus* L., *L. garmani* Cope.

Scytalinæ. *Tachymenis strigatus* Gthr., *Phalotris lemniscatus* D. and B., *P. tricolor* D. and B., *Erythrolamprus bipunctatus* Gthr.

Natricinæ. *Cerberus boæformis; Pseudaspis cana* L.

Acrochordidæ.

Chersydrus granulatus Merr. In this species the heart is at the middle of the length of the body, and the normal lung is posterior to it, extending nearly to the vent. No rudimental lung. A tracheal lung, composed of coarse cells and without lumen, extends from the heart to the head, and is discontinuous with the true lung. The trachea is closed, but communicates with the tracheal lung by a series of symmetrical pores on each side.

Najidæ.

One lung and a rudiment, no tracheal lung. *Pseudechis porphyriacus* Shaw, *Diemenia reticulata* Gray, *Naja tripudians* L., *Bungarus semifasciatus* Kuhl.

Elapidæ.

No rudimental nor tracheal lung. *Elaps lemniscatus* L., *E. fulvius* L., *E. corallinus* L., *E. multifasciatus* Jan.

Hydrophidæ.

I. One lung and no rudiment, continuous with tracheal lung, which extends to head.

Hydrophis hardwickii Gray (a slight constriction between tracheal and posttracheal lungs), *H. elliotti* Gthr.; *Hydrus bicolor* Daud.

II. A rudimental right lung connected with the left lung, which is separate from the large tracheal lung.

Platurus laticaudatus L.

SOLENOGLYPHA.

A tracheal lung, continuous with the normal lung.

Causidæ.

No rudimental lung.
Causus rhombeatus Licht.

Dendraspididæ.

No rudimental lung.
Dendraspis polylepis Gthr.

Viperidæ.

No rudimental lung.
Clotho arietans L.

Crotalidæ.

I. No rudimental lung.

Bothrops lanceolatus L. *Ancistrodon piscivorus* Lacep. *Crotalophorus catenatus* Raf. *Crotalus adamanteus* Beauv. *C. confluentus* Say.

II. With a rudimental right lung.

Bothrops pictus Tsch. *B. erythrurus* Cant. *Teleuraspis schlegelii* Berth. *Ancistrodon contortrix* L. *Crotalus horridus* L.

THE SYSTEMATIC VALUE OF THE PULMONARY CHARACTERS.

I have no doubt of the propriety of the separation of the Ungualidæ from the other Peropoda on account of its pulmonary characters. Nor is there any doubt in my mind of the necessity of the separation of the Leptognathinæ from the Xenodontinæ for similar reasons. The genus Heterodon differs very much from the Xenodontinæ in the possession of an enormous diverticulum of the lung, but as it is not present in the allied genus Lystrophis Cope, its wider distinction may be a questionable proceeding. The very marked characters of the genus Chersydrus characterize the family as well as the osteological characters. It remains to be seen whether the family I termed the Nothopidæ, but which Boulenger unites with the Chersydridæ, agrees with it in pulmonary characters. The remarkable tracheal lung or gland distinguishes the Epanodonta from the Catodonta, emphasizing that observed in the osteology of the skull. The peculiar form and relations of the maxillary bone in this group resemble those of the Solenoglypha, and there may be some possible connection between the groups. The tracheal body may be a degenerate tracheal lung, such as that division possesses.

The value of the rudimental right lung as a character of the Colubroidea is increased by my investigations. In only two genera have I found it present or absent, viz. Halsophis and Pityophis. I am not sure but that I may yet find it in the *P. melanoleucus*, where I have failed hitherto, but I am sure that it is present in some species of Halsophis and wanting in others. A natural group of American Colubrinæ appears to be characterized by its absence, viz. Rhinochilus, Cemophora and Ophibolus, all genera with an entire anal shield. The development of cartilages in the bronchial foramen or tube of the rudimental lung is not a constant character. I found it in one *Heterodon platyrhinus* and not in another; it is present in *Conophis pulcher*, but absent in *C. sumichrasti*.

The rudimental lung is often concealed from view and difficult to discover. The best test of its presence is the foramen which connects it with the trachea, which will generally be found piercing the cartilage of the latter near the apex of the heart. The rudimental organ may then be found by inserting a bristle, and observing its destination through the more or less transparent tissues. In but one instance have I found a rudimental lung without a connecting foramen, viz., in the Mexican *Ficimia olivacea*. On the other hand, the foramen may terminate in a small blind sac.

The pulmonary characters may be determined without much dissection. The position of the heart must be first ascertained, and a longitudinal median incision made in the abdominal wall. In all forms except the Epanodonta and Catodonta, the trachea will be found passing to the left side of the heart, and entering the lung near its apex. By splitting the trachea, not too near its abdominal border, on turning the free margin upwards as the snake lies on its back, the *foramen bronchiale* will be seen and its lumen can be explored. The trachea is concealed by the œsophagus, which must be drawn to the left side of the body in order to make the examination. The examination of the tracheal lung requires the division of the abdominal wall further towards the head.

EXPLANATION OF PLATES.

The figures variously reduced; the heart and liver are turned over to show the trachea and lungs.

Plate XI.

Typhlops liberiensis Hallow.

Plate XII.

Charina bottæ Blv.

Plate XIII.

Chersydrus granulatus Merr.

Plate XIV.

Coluber quadrivittatus Holbr.

Plate XV.

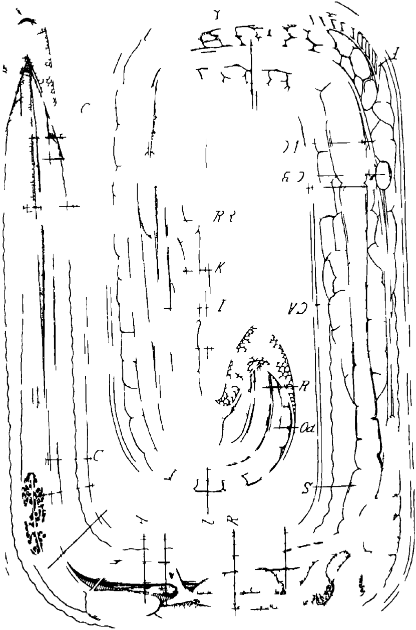
Heterodon platyrhinus Latr.

Plate XVI.

Crotalus confluentus Say.

Lettering.

Œ., Œsophagus; *St.*, Stomach; *I.*, Intestine; *R.*, Rectum; *C.*, Cæcum; *Tr.*, Trachea; *R. L.*, Right lung; *L. L.*, Left lung; *T. L.* Tracheal lung; *B. F.*, Bronchial foramen; *L.*, Liver; *G.*, Gall bladder; *K.*, Kidney; *U.*, Ureter; *T.*, Testis; *V. D.*, Vas deferens; *Ov.*, Ovary; *Od.*, Oviduct; *V.*, Vagina; *F.*, Fontanelle; *C. A.*, Corpus adiposum; *H.*, Heart; *A. R.*, Aorta root; *Car.*, Carotid; *J.*, Juglar vein; *V. C.*, Vena cava.



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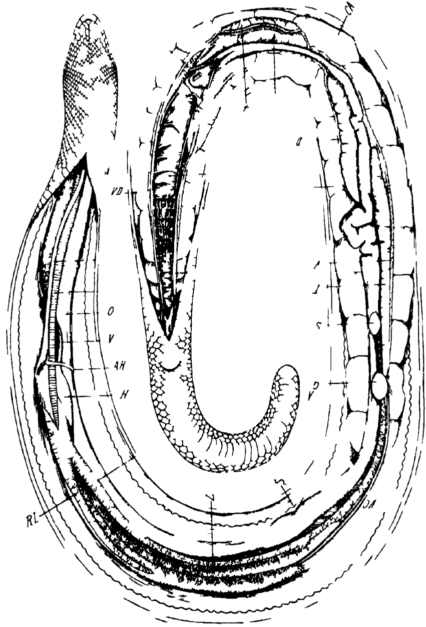
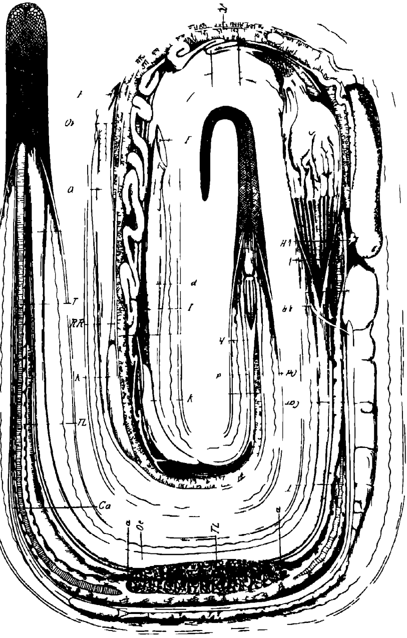
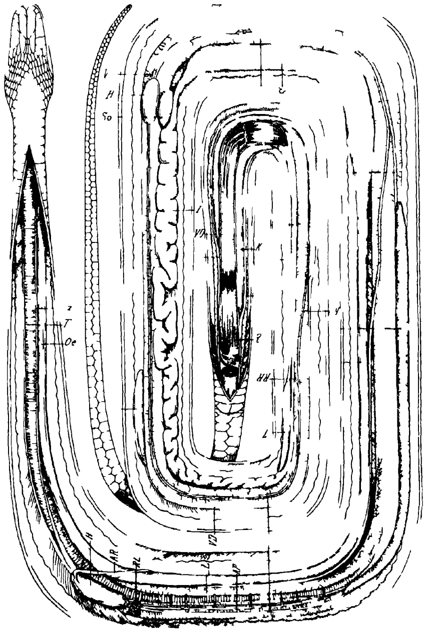


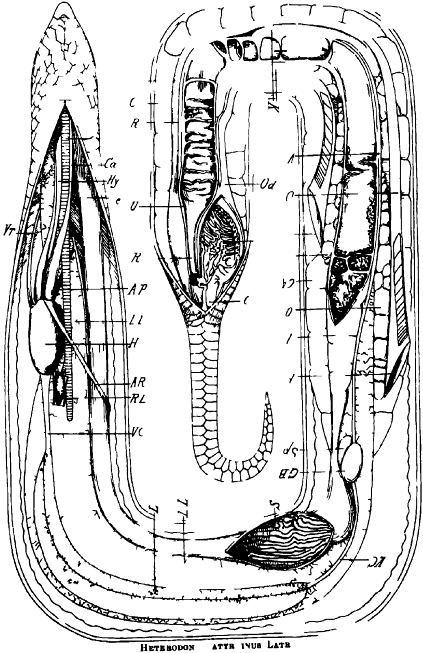
CHARINA BOTTÆ Bl.



Chersydrus granulatus Merr



Coluber quadrivittatus Holbr.



HETERODON PLATYRHINUS LATR.

A Comparative Study of the Chemical Behavior of Pyrite and Marcasite.

By Amos Peaslee Brown.

(Read before the American Philosophical Society, May 18, 1894.)

While much has been done in the way of investigating the chemical properties and constitution of the various artificial chemical compounds, comparatively little attention has been paid to the constitution of the naturally occurring chemical compounds. The carbon compounds, for instance, have in an immense number of cases been investigated with sufficient exactness to allow of our expressing their constitution by means of structural formulæ, but to how many minerals, aside from the simplest compounds, can we assign structural formulæ that are based on any knowledge that we possess of their reactions? It is true that much has been done in the way of the artificial production of minerals and some knowledge of the constitution of certain minerals has been arrived at by a study of their decomposition products, but very little in comparison to the extent of the field. There are probably several reasons for this neglect of the study of the chemical properties and constitution of minerals, as want of homogeneity in the minerals themselves, difficulty of procuring or separating pure material for investigation, and similar difficulties which do not so frequently occur with artificial compounds. It thus happens that mineral chemistry is not as much studied as it deserves to be. Certain groups of minerals have, however, received some attention; for instance, Prof. F. W. Clarke has been carrying on a very interesting series of investigations on the constitution of certain silicates which have been productive of most valuable results. The natural sulphides, sulpharsenides and sulpho salts present some very interesting problems in regard to their constitution, and it was with a view of adding to our knowledge of the chemical behavior of two of these sulphides that I undertook the series of investigations about to be described.

The compound FeS_2 is found in nature in two well known forms—the one Pyrite (the isometric mineral) and the other Marcasite (the orthorhombic mineral). Since the separation of the two names from the general term pyrites, it has been recognized that the orthorhombic form is lighter in color and also of lower specific gravity than the isometric form. From early times also, the greater tendency of "white pyrites," or marcasite, to decompose in the air was well known.

Pyrite, the form which resists atmospheric weathering most thoroughly, is of a bright brass yellow color and metallic lustre, breaking with an uneven conchoidal fracture, but bright on the surface of fracture. It crystallizes in the isometric system in forms showing generally pentagonal hemihedrism. Its specific gravity ranges from 4.8 to 5.2, averaging somewhat over 5. The brass yellow crystals are generally quite unaltered in the air.

Marcasite on the other hand has a pale greenish or grayish yellow color an uneven fracture which shows a somewhat fibrous structure and generally but little lustre on the surface of fracture It crystallizes in the orthorhombic system very commonly in twins or radiated fibrous masses It is not very permanent in moist air but readily decomposes and largely into $FeSO_4$ The chemical formula of either form calculated from quantitative analyses is the same FeS_2 or Fe = 46 67% S = 53 33%

The chemical study of these two minerals has been mainly confined to the formation of one of them artificially and to a few experiments on their relative decomposability Pyrite has been made artificially in a number of ways marcasite has not as yet been formed artificially * In 1836, Wöhler † produced cubes and octahedra of pyrite by subjecting a mixture of ferric oxide flowers of sulphur and ammonium chloride to a temperature a little above the volatilizing point of the ammonium chloride The resulting mass was washed to isolate the crystals from the accompanying pulverulent matter Stanislas Meunier ‡ modified this method by mixing equal parts of ferrous carbonate and sulphur and heating in glass tubes over a moderate flame When the excess of sulphur has been driven off there remains a black powder containing a considerable percentage of cubes of pyrite Dana § states that pyrite may be made by slow reduction of ferrous sulphate in presence of some carbonate Baubigny ‖ produced FeS_2 as a crystalline crust by acting on metallic iron by a solution of SO_2 in water (H_2SO_3) in closed tubes and at a temperature of 200° As neither this experiment nor the one immediately preceding it shows that the crystals were isometric it is possible that both of them may be marcasite Henri Saint Claire Deville ¶ produced cubes of pyrite by melting a mixture of potassium sulphide (K_2S) and iron sulphide (FeS) in presence of excess of sulphur This reaction if correct as to the *cubical* product is a remarkable one as I should rather expect marcasite to result under such conditions Senarmont ** produced FeS_2 by decomposing a salt of iron by an alkaline sulphide at an elevated temperature in sealed glass tubes The product was an amorphous black powder, not altering on exposure to air and not attacked by hydrochloric acid This may have been pyrite, as marcasite is readily decomposed by moist air Rammelsberg †† in 1862 made FeS_2 pseudomorphs after ferric oxide (Fe_2O_3) by passing a current of hydrogen sulphide over it at a temperature between 100° and a red heat The product of this reaction would likely be pyrite

In nature it would seem that in most cases the sulphide of iron first formed is FeS but probably by action of a ferric salt or carbonic acid (H_2CO_3) causing a loss in iron FeS_2 results and this is almost always pyrite On the other hand where ferrous sulphate has been reduced by slow action of decomposing organic matter the resulting sulphide seems to be generally marcasite which if not in crystals may be recognized by its ready weathering to ferrous sulphate ($FeSO_4$) This compound may however in many cases be a mixture of pyrite and marcasite as much pyrite seems to be * These several ways in which pyrite may be formed are of importance as indicating the condition of the iron in the compound and will be referred to later on

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* Doelter *Zeit. für Kryst* xi 81 1885 cf Dana *Syst Min* 1892

† *Pogg Ann* xxxvii p 238

‡ *Les Méthodes de Synthèse en Minéralogie* S Meunier 1891

§ J D Dana *System of Mineralogy* edition of 1868 p 64

‖ S Meunier *Synth Min.* p 29

¶ Cited in *Dict Chem* of Wurtz by E. Wilm article Iron, T I, p 1114

** S Meunier *Synth Min* p 285

†† *Jour für Praktische Chemie* T lxxxviii p 266

Equally important as bearing on the constitution of these sulphides are the observations that have been made as to their decomposition under atmospheric agencies On exposing crystallized pyrite to atmospheric weathering it is generally found that but little if any change takes place even in a year s time while crystallized marcasite under the same conditions shows a rapid weathering The main product of the weathering of pyrite in nature is the compound limonite $Fe_4O_3(OH)_6$ which occurs in large quantities in nature evidently derived from pyrite Its pseudomorphs after pyrite are very common On the other hand when marcasite weathers a very large percentage of ferrous sulphate ($FeSO_4$) is formed with a comparatively small percentage of limonite unless the marcasite decomposes underground and under pressure when limonite is largely produced † Much of the excess of sulphur with marcasite is changed to sulphuric acid but with pyrite much remains behind as sulphur Some comparison of the rate of oxidation of these two minerals in the air is afforded by an examination of specimens in a collection. Here it will be found that most of the pyrite is unchanged but nearly every specimen of marcasite will show tarnish if no other sign of oxidation and often a considerable coating of oxide can be seen or a white efflorescence of $FeSO_4$

Chemical investigations of these two minerals have been mainly in the way of analysis but some experiments have been made in the way of studying their relative behavior towards certain reagents Before describing my experiments it will be necessary to briefly mention some of these

Both minerals are decomposed by a solution of silver nitrate and gold chloride the decomposition taking place quite rapidly ‡ My experiments in this connection are mentioned later

A A Julien § has shown that different samples of pyrite show a difference in their reaction with bromine vapor His experiments consisted in exposing finely ground pyrite to the action of bromine vapor at the tem

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* Compare A A. Julien Decomposition of Pyrite *Ann N Y Acad Sci* Vols ii and iv

† Blum *Pseudomorphosen* 1843 pp 19 199

‡ S Meunier *Synth. Min* p 300

§ A A Julien *Ann N Y Acad Sci* Vol iv pp 151 155.

perature of the air for twelve hours The residue was extracted with dilute H_2SO_4, which removed the iron rendered soluble (bromide), and the iron was then determined in this solution The percentage of iron that had dissolved varied from 2 43 to 15 20 per cent, although all samples tested are described as pyrite He also tried the action of bromine in aqueous solution, but the reaction was too rapid to give any comparative results.

Much more important are the results obtained in the oxidation of these minerals by the electric current as conducted by Prof Edgar F. Smith,[*] and it was the remarkable results that were then obtained that induced me to continue the study of the comparative reactions of these two minerals Smith found that a current which would completely oxidize the sulphur in marcasite in a given time would oxidize less than half of the sulphur in pyrite in the same time This remaining sulphur was held very tenaciously, though the mineral was subjected to more powerful currents and longer continued action than in the case of marcasite or pyrrhotite. Finally, by adding an equal quantity of CuO, and using a more powerful current, all of the contained sulphur was oxidized Previous to the addition of CuO but 21 or 22 per cent of the sulphur was oxidized In concluding the article above referred to the author questions whether the crystalline form alone can make this difference in the action of the two minerals when under the influence of the current

The two samples of pyrite and marcasite that I selected for the following study were chosen after considerable examination of material as being typical of the two forms of FeS_2 The pyrite was from the hematite mines of Elba. It is exceptionally pure and free from decomposition or tarnish Before deciding on it finally pieces were ground and polished and then examined under the microscope with powers ranging from 50 to 200 diameters, in order to see if it contained any enclosures or varied in texture It was perfectly homogeneous and showed no enclosures It took a high polish The crystals showed the combination of octahedron and pentagonal dodecahedron $O + \frac{\infty O2}{2}$. Some of the crystals were coated in places with scales of hematite, but this was all carefully removed in breaking up material for experiment. The color was bright brass-yellow, the specific gravity was determined as 5 179. The marcasite was from the zinc mines of the Subcarboniferous of Joplin, Jasper county, Mo, finely crystallized in polysynthetic twinnings. The freshly broken crystals show a greenish yellow color, almost white, but they tarnish readily with bluish or brownish colors. No gangue was present, everything dissolving completely in nitric acid. This marcasite was examined with the microscope in the same way as the pyrite; it did not take such a high polish on account of a fibrous structure, but no foreign matter was found with a power of 200 diameters. Its color was uniform throughout, showing that no pyrite was present. The specific gravity as determined was 4 844.

In preparing material for experiment only sufficient was ground for immediate use to avoid any chance of oxidation of the ground material the stock samples of the two minerals broken to nut size were kept in stoppered bottles The grinding of material was continued as long as grit appeared but no bolting was resorted to

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[*] *Jour. Franklin Inst.*, Vol cxxx, pp. 150-154.

As the experiments of Prof Smith on oxidation by the electric current showed such remarkable results my first experiments were on oxidation As an oxidizing agent potassium permanganate ($KMnO_4$) was used several strengths of which were tried for varying intervals of time with each mineral and the amount of sulphur oxidized to sulphuric acid determined in the liquid by precipitating as barium sulphate The object was to secure a complete series of results which would show the comparative rates of oxidation of the sulphur in the two minerals Neutral aqueous solutions of the potassium permanganate were used and the strengths of solution employed were $\frac{1}{100}$ normal one per cent three per cent and five per cent the periods of oxidation extending over one two three four and five hours and the entire series being performed at ordinary temperatures and at 100° As duplicate determinations were made in the majority of cases (I made about 130 determinations of sulphur as barium sulphate) this work consumed a large amount of time and prevented as full a study of some other reactions of the two minerals as had been originally intended The following are the detailed descriptions of my processes and results

ACTION OF $\frac{1}{100}$ NORMAL POTASSIUM PERMANGANATE SOLUTION AT ORDINARY TEMPERATURE

These oxidations were performed as follows Two tenths of a gram of the finely powdered mineral was placed in a stoppered bottle of about 100 c c capacity then 50 c c of the permanganate solution added and the contents of the bottle violently shaken to break up lumps This shaking was repeated about every fifteen minutes while the oxidation lasted The temperature of the room was at the same time recorded As stated, the oxidation was continued for one, two three four and five hours with each mineral making at least ten experiments necessary for each strength of solution After the solution had acted for the required time it was rapidly filtered through asbestos with aid of the filter pump the filtrate transferred to a beaker 20 c c of concentrated hydrochloric acid added, and the whole heated until all manganese was reduced to manganous chloride If not too acid the solution was then diluted to about 800 c c and the sulphuric acid precipitated as barium sulphate When very acid, excess of hydrochloric acid was removed by evaporation or by adding ammonia, the ammonium chloride seeming to facilitate the precipitation. The precipitate was washed with hot water and then weighed All precipitations were made at boiling temperature and digested hot for at least two hours and then cold for at least twelve hours more before filtering The filtrates from most of the cold tests were re duced with metallic zinc and titrated with permanganate, but no iron was found in the solution

The two minerals did not present the same appearance when acted on by the oxidant. Pyrite retained its color and seemed as pulverulent as when the permanganate was added, but marcasite immediately on the addition of the reagent became coated with manganese dioxide, took on a brownish color, and showed a tendency to cake together and stick to the sides of the bottle, so that it was with difficulty dislodged This tendency of the marcasite was more marked with stronger solutions of the permanganate and was doubtless the cause of much of the irregularity that will be noticed in the results. The reason for this difference in action of the reagent on the two minerals will be discussed later on

The percentages of sulphur oxidized in the two minerals by this method are shown in the following table, where all results that were obtained are recorded The figures show the percentages of sulphur oxidized, calculated on the basis of FeS_2 equal to one hundred per cent. It will be noted that the four hour oxidation of marcasite shows a result that is less than the two hour This was due to caking of the mineral against the walls of the bottle, which prevented much of it from coming in contact with the solution On the whole, this series was about the most satisfactory of the cold experiments with $KMnO_4$, the action of this dilute solution being less rapid and hence more even than that of the more concentrated solutions, naturally the action ceases with a certain dilution, and hence the four- and five-hour oxidations of pyrite are about equal.

Table Showing the Relative Oxidation of Sulphur in Pyrite and Marcasite by a $\frac{1}{100}$ N. Solution of $KMnO_4$ at 22°.

MINERAL.	1-HOUR.	2 HOUR	3-HOUR.	4-HOUR.	5-HOUR.
Pyrite with $\frac{1}{100}$ N solution $KMnO_4$	78	1.17	1.83	1.74	1.72
Marcasite with $\frac{1}{100}$ N. solution $KMnO_4$....................	1.07	1.86	2 04	(1 25)	2.38

The curves formed by plotting these results on rectangular coördinates are shown in Pls. xvii and xviii. They are marked 22° M_1 for the marcasite and 22° P_1 for the pyrite.

ACTION OF 1 PER CENT. POTASSIUM PERMANGANATE SOLUTION AT ORDINARY TEMPERATURE.

This and also the two following series were performed as described under $\frac{1}{100}$ normal solution above. At least two experiments were tried with each mineral in this and the two following cold oxidations. and whenever a result was notably higher or lower than its duplicate a third or fourth was tried The tendency of the marcasite to cake noted in the previous series became still more marked here and is doubtless the cause of one of the four hour oxidations (marked by parenthesis) being notably lower than the three hour Such a result is obviously incorrect On the other hand the result in the three hour column which is placed in parenthesis is the highest obtained This experiment was made at the same time as the one showing 1 93 per cent but the room was very warm (25°) which may in part account for this high result It will be noticed that the oxidation of the pyrite seems to stop at the three hour trial those following showing no appreciable increase This is well seen in the graphic representation of these oxidations (Pls xvii and xviii)

Table Showing the Relative Oxidation of Sulphur in Pyrite and Marcasite by a 1 Per Cent Solution of $KMnO_4$ at 22°

MINERAL	1 HOUR	2 HOUR	3 HOUR	4 HOUR	5 HOUR
Pyrite with 1 per cent solution $KMnO_4$ cold	1 72 1 71	1 38 1 47	1 85 1 87	1 79 1 90	1 70 1 89
Marcasite with 1 per cent solution $KMnO_4$ cold	1 16 1 28	1 29 1 13	1 93 2 19 (3 92)	1 95 (1 56) 2 69	2 01 2 15 2 55

ACTION OF 3 PER CENT SOLUTION OF POTASSIUM PERMANGANATE AT ORDINARY TEMPERATURE

The conditions of this series of experiments were the same as those of the last The tendency of the results to fluctuate instead of showing a gradual progression is now very marked One of the one hour pyrite oxidations shows more sulphur oxidized than is shown by any other individual result of the series No explanation can be offered for such a discrepancy as this On the other hand the high result shown in the three hour oxidation is quite easily explained by the marcasite having been little if any caked in this experiment The two low results of pyrite three hour and marcasite four hour oxidations are readily explicable on the ground of caking of the material As the barium sulphate was often determined several days after the oxidation was completed it is obvious that no reliable notes could be made concerning the caking or non caking of the mineral in the permanganate With this strength of solution it is evident, too, that the main action of the permanganate is complete at the end of one hour, notably in the case of the marcasite and it is only when very vigorous agitation exposes fresh surfaces of the mineral to the action of the $KMnO_4$ that any further action can take place We therefore see that marcasite in one hour gives up as much sulphur as in five hours, and this is very graphically shown on Pl xvii

Table Showing the Relative Oxidation of Sulphur in Pyrite and Marcasite by a 3 Per Cent Solution of KMnO₄ at 22°

Mineral	1-Hour.	2-Hour	3-Hour.	4-Hour.	5-Hour
Pyrite with 3 per cent solution $KMnO_4$ cold	1.65 (3 55)	• 2 23 2 31	2 80 (1.58)	2 47 2 62	2 81 2 28
Marcasite with 3 per cent solution $KMnO_4$ cold	2 72 2 87	2.17 2 33	2 67 (3.81)	2 88 (1 80)	2 81 2 77

Action of 5 Per Cent Solution of Potassium Permanganate at Ordinary Temperature.

In this series, as in the last, the action, as far as pyrite was concerned, was practically complete at the expiration of the first hour, but in the case of the marcasite this point was not reached until probably the end of the second hour, and, in fact, in one case was progressive to the end But one very great discrepancy is to be noted here in the three-hour column with marcasite The low result in the next column is explained by caking.

Table Showing the Relative Oxidation of Sulphur in Pyrite and Marcasite by a 5 Per Cent. Solution of KMnO₄ at 22°

Mineral.	1-Hour	2-Hour	3-Hour.	4-Hour	5-Hour.
Pyrite with 5 per cent. solution $KMnO_4$ cold.	2 39 3 15	3 03 3.15	3.22 2.32	2 89	2 79 3 24
Marcasite with 5 per cent solution $KMnO_4$ cold.	2.10 2.52	3 06 3.76	3 82 (5 83) 2.77	3.16 (2.44)	3 39 4.17

This series finishes the experiments at ordinary temperatures. In all of them the action was comparatively slight, not exceeding at most 10 per cent. of the contained sulphur in the mineral which would not be sufficient to show any marked difference between the two minerals as bearing on their constitution, if the constitution which seems to be indicated by subsequent experiments (to be presently described) is the true one.

The oxidations with potassium permanganate at a temperature of 100° were conducted by suspending the vessel containing the mineral and solution in boiling water. Both stoppered bottles and thin glass flasks closed with perforated corks were used for this series of experiments. The water was kept continually boiling and the bottles or flasks were immersed deep enough to cover that portion of them containing the permanganate. Six or eight oxidations were made at one operation. The permanganate solution after it had acted the required time was treated as in the experiments conducted at ordinary temperatures described above. Much more active oxidation took place at this temperature (100) but the tendency of the mineral to cake together was much more marked and now this took place with pyrite as well as with marcasite. Moreover the deposition of manganese dioxide in every case was now very great causing often a stoppage of the oxidation until it could be dislodged. As these oxidation experiments had already occupied much time only one trial was now made at each concentration of solution for each hour from one to five unless as before marked discrepancies occurred when two or more trials were made. The series of results are hence not so regular as they would have been had more trials been made these irregularities arising from the difficulties that have been mentioned as well as from the fact that the dilute solutions soon became exhausted and that all solutions suffered some evaporation but some more than others causing irregular strength with the same solution. Nevertheless the results agree in kind with those obtained at ordinary temperature but differ widely in degree. Whereas at ordinary temperature the greatest amount of sulphur oxidized in marcasite by the five hour trial with [illegible] per cent permanganate was 4 17 per cent at 100° this became 16 86 per cent or about four times as much.

ACTION OF $\frac{1}{100}$ NORMAL POTASSIUM PERMANGANATE SOLUTION AT 100

The results given in the following table show perhaps more strongly than either of the other series of experiments at 100 the effect of the different disturbing causes that have been mentioned. It especially shows the effect of caking of the pyrite which now came in as an important disturbing factor. The result of this caking is shown in the three and four hour results with pyrite both being very low. Marcasite on the other hand invariably caked and stuck to the bottom of the bottle but as this was a constant source of error in this case the results show a gradual and fairly even increase. Irregular results with marcasite were now largely conditioned by the evaporation of the solution or by the fact of whether the mineral was evenly caked over the inner surface of the vessel or concentrated in spots. The result of this latter way of caking will be better seen in some of the subsequent series of experiments.

Table Showing the Relative Oxidation of Sulphur in Pyrite and Marcasite by a $\frac{1}{100}$ Normal Solution of $KMnO_4$ at 100° C

MINERAL	1 HOUR	2 HOUR	3 HOUR	4 HOUR	5-HOUR
Pyrite with $\frac{1}{100}$ N $KMnO_4$ at 100° C	4 95	4 79	3 86	3 04	5 64
Marcasite with $\frac{1}{100}$ N $KMnO_4$ at 100° C . . .	3 17	3 64	3 76	5 68	5 61

ACTION OF 1 PER CENT. POTASSIUM PERMANGANATE SOLUTION AT 100°

The results of the oxidation shown in this series are chiefly remarkable as still further illustrating the action of the solution on the caked material, as shown in the four- and five-hour trials with pyrite and the four-hour trial with marcasite This latter shows, too, the effect of having the caked mineral massed in one spot. With this exception, the marcasite oxidations are progressive and fairly uniform (the two hour trial falls somewhat below what it doubtless should be), but the pyrite shows a sharp fall in the four- and five hour trials. The cause of this has been indicated. That the concentration of the solution by evaporation caused an increase in the action seems to be indicated by the result of the five-hour marcasite oxidation, but this is much more strongly marked in the 5 per cent. series in the case of pyrite, which will be referred to later on

Table Showing the Relative Oxidation of Sulphur in Pyrite and Marcasite by a 1 Per Cent Solution of $KMnO_4$ at 100°.

MINERAL	1-HOUR.	2 HOUR.	3-HOUR.	4 HOUR	5-HOUR.
Pyrite with 1 per cent. $KMnO_4$ at 100° C.	6 03	6 98	8 33	6 11	6.88
Marcasite with 1 per cent. $KMnO_4$ at 100° C	6 43	5.61 6 25	6.56	7.40	9 10

ACTION OF 3 PER CENT. SOLUTION OF POTASSIUM PERMANGANATE AT 100° C.

The average results of this series of oxidations were very good, with the exception of two members of the series—the marcasite five-hour trial and the pyrite three-hour This latter was repeated, but with a similar low result. Leaving these two out of account, the average results show a very fairly even rate of progression, which have been brought out in the diagram (Pl xvii) It is evident from an inspection of the following table that the marcasite oxidations of the four- and five-hour trials were arrested by some disturbing influence.

Table Showing the Relative Oxidation of Sulphur in Pyrite and Marcasite by a 3 Per Cent. Solution of $KMnO_4$ at 100° C.

MINERAL.	1-HOUR.	2-HOUR.	3-HOUR.	4-HOUR.	5-HOUR.
Pyrite with 3 per cent. $KMnO_4$ at 100° C.	5 53 (7.01)	5.77 7.89	6.61 5.16	10.73	11.09
Marcasite with 3 per cent. $KMnO_4$ at 100° C.	5.25 5.50 (8.67)	7.97	9.42	9.80	7 53

ACTION OF A 5 PER CENT POTASSIUM PERMANGANATE SOLUTION AT 100° C

This series was decidedly the most satisfactory of the experiments conducted at 100° and with the exception of the two hour oxidations in case of each mineral shows a remarkably regular increase in the oxidation of the sulphur It illustrates too in the case of the pyrite the effect of the concentration of the solution due to evaporation This causes a more rapid rise in the results after three hours action and notably between four and five hours This rise is not so well seen from the table as from the plot of the results given in Pl xvii Here this rising of the curve after three hours is very marked as contrasted with the curve of the marcasite oxidations

Table Showing the Relative Oxidation of Sulphur in Pyrite and Marcasite by a 5 Per Cent Solution of $KMnO_4$ 100°

MINERAL	1 HOUR	2 HOUR	3 HOUR	4 HOUR	5 HOUR
Pyrite with 5 per cent $KMnO_4$ at 100° C	7.95	7.52	9.85	11.86	14.98
Marcasite with 5 per cent $KMnO_4$ at 100° C	8.88	8.88	13.27	14.85	16.80

The graphic representation of the rate of oxidation of sulphur in these two minerals is plotted from the following tables the first of which shows the average amounts of oxidation of sulphur compiled from the several small tables already given In this compilation I have omitted a few of the results given in parentheses in the small tables as they are evidently incorrect and would vitiate the averages On the other hand I have simply retained the parentheses of the small tables in certain cases where but one result was obtained The second table also compiled from the several small tables shows for the experiments at ordinary temperature the result of selecting wherever possible such individual determinations as show a progressive increase in the oxidation *In this way more regular series of results are obtained* Inasmuch as the variations are so marked this method of selecting results seems justified at least for obtaining a comparison of the relative rates of oxidation of the sulphur in the two minerals The results of Table I are plotted in Pl xvii and those of Table II in Pl xviii

I *Table Showing Average Relative Oxidation of Sulphur in Pyrite and Marcasite by Solutions of $KMnO_4$ at 22° and at 100°.* See Pl xvii

MINERAL.	1-HOUR	2-HOUR	3-HOUR	4-HOUR	5-HOUR	ON PL.
Pyrite $\frac{1}{100}$ N. cold .	78	1.17	1.88	1.74	1.72	22° P_1
Marcasite $\frac{1}{100}$ N cold	1.07	1.84	2.04	(1.25)	2.38	22° M_1
Pyrite 1 per cent cold	1.71	(1.48)	1.86	1.85	1.60	22° P_2
Marcasite 1 per cent cold....	1.28	1.21	2.06*	2.82*	2.24	22° M_2
Pyrite 3 per cent. cold . .	2.55	2.37	2.60*	2.55	2.55	22° P_3
Marcasite 3 per cent cold....	2.80	2.25	2.87*	2.88*	2.60	22° M_3
Pyrite 5 per cent. cold ...	2.77	3.09	2.77	2.89	3.02	22° P_4
Marcasite 5 per cent cold ...	2.31	3.41	3.80*	3.16	3.78	22° M_4
Pyrite $\frac{1}{100}$ N 100° . . .	4.05	4.73	3.86	2.04	5.64	100° P_1
Marcasite $\frac{1}{100}$ N 100° ..	3.17	3.84	3.76	5.68	5.61	100° M_1
Pyrite 1 per cent. 100° . .	6.03	6.98	6.88	6.11	6.88	100° P_2
Marcasite 1 per cent. 100°. ..	6.48	5.98	8.56	7.40	9.10	100° M_2
Pyrite 3 per cent 100° . .	6.20	6.83	6.81*	10.78	11.08	100° P_3
Marcasite 3 per cent. 100° . .	6.47	7.97	9.42	9.80	(7.55)	100° M_3
Pyrite 5 per cent 100° . .	7.95	7.52	9.85	11.86	14.98	100° P_4
Marcasite 5 per cent 100° ..	8.38	8.38	13.27	14.85	16.36	100° M_4

II *Table Showing Selected Results of the Oxidation of Sulphur in Pyrite and Marcasite by Solutions of $KMnO_4$ at 22°* See Pl xviii.

MINERAL.	1-HOUR	2-HOUR	3-HOUR	4-HOUR	5-HOUR	ON PL.
Pyrite $\frac{1}{100}$ N. cold	.78	1.17	1.88	1.74	(1.72)	22° P_1
Marcasite $\frac{1}{100}$ N. cold	1.07	1.86	2.04	(1.25)	2.38	22° M_1
Pyrite 1 per cent. cold	(1.71)	1.47	1.85	1.90	1.69	22° P_2
Marcasite 1 per cent cold ...	1.16	1.29	1.98	1.95	2.15	22° M_2
Pyrite 3 per cent. cold	(1.65)	2.31	2.80	(2.62)	2.61	22° P_3
Marcasite 3 per cent. cold	(2.79)	2.83	2.87	2.88	2.88	22° M_3
Pyrite 5 per cent. cold	2.89	3.03	3.22	(2.89)	3.24	22° P_4
Marcasite 5 per cent. cold .	2.52	3.06	3.69	(3.16)	4.17	22° M_4

In plotting from these tables a vertical scale of one-half inch per one per cent. of sulphur oxidized and a horizontal scale of three-quarters inch per hour of oxidation have been employed. Wherever there was a drop in the results the gap has been bridged over by the main curve, thus making the curves as nearly as possible progressive, but the drop has been plotted in fine dotted lines. On examining these curves the points as to the relative rates of oxidation that have been mentioned are shown very graphically, the curve of the marcasite oxidation rising in each case above the corresponding one of pyrite, but both showing a similar form. Of these curves the $\frac{1}{100}$ normal solution cold and the 5 per cent. solution hot

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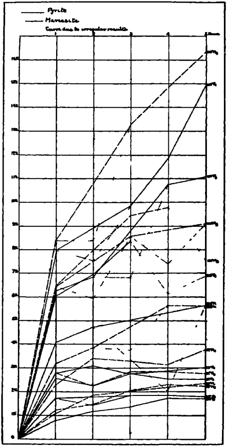
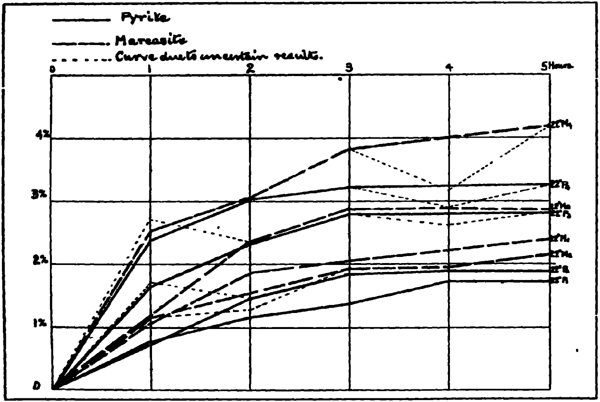
* Obtained by omitting discordant results.


Pyrite
Marcasite
Curve due to irregular results
1
2
3
4
5 Hours
16%
15%
14%
13%
12%
11%
10%
9%
8%
7%
6%
5%
4%
3%
2%
1%
0


Pyrite
Marcasite
Curve due to uncertain results.
0
1
2
3
4
5 Hours
0
1%
2%
3%
4%

are the most regular No very marked difference in the rate of oxidation is brought out by this series of experiments, the amount of sulphur oxidized never having reached the critical point in pyrite, as shown by Prof. Smith's oxidations with the current already described This point at which the rate of oxidation of sulphur in pyrite suffers a change was found by Prof. Smith to be between 21 and 22 per cent from the results of a very large series of current oxidations * The explanation for this being the critical point in the oxidation of pyrite will be given in the discussion of its constitution The experiments with permanganate oxidation simply show then that up to near this point (the highest point reached in the pyrite oxidation was nearly 15 per cent) the relative rates of oxidation of the two minerals do not differ widely from each other, but that marcasite oxidizes somewhat faster than pyrite This is simply what has been long known and recognized in regard to atmospheric weathering

As will be seen when the constitution of these minerals is considered, marcasite cannot have a critical point in regard to oxidation of its sulphur

The experiments thus far described had for their object the removal of sulphur. On the other hand, a number of ways of attacking the iron were tried and with more interesting results In these trials reagents were selected which would attack the iron more energetically than the sulphur. Among these may be classed the experiments of solubility in acids

Hydrochloric acid (hot or cold, concentrated or dilute) has little action on these minerals. Pyrite was treated for one hour with boiling concentrated HCl, of specific gravity 1 20 in covered beakers and showed in the solution only 2 56 per cent of iron out of 46 67 per cent. Marcasite, treated in the same way, gave an identical result. Similar experiments at the ordinary temperature were tried with both minerals, by digesting for three days with excess of concentrated hydrochloric acid and with excess of $2\,HCl + 3\,H_2O$, but even after three days the action was very slight in both cases. Pyrite gave with both concentrated and dilute acid the same result—a solution of 1 51 per cent. of iron Marcasite gave almost identical results. The concentrated hydrochloric acid solution showed 1.51 per cent. of iron, the dilute solution 1.59 per cent. No evolution of hydrogen sulphide was detected by lead paper in either case Concentrated sulphuric acid at boiling temperature decomposes both minerals, with evolution of sulphur dioxide and the separation of sulphur, but the action is very slow and seems to take place more readily with pyrite than with marcasite. Pyrite digested with concentrated sulphuric acid at boiling temperature for one hour showed 14.81 per cent. of the iron dissolved, but marcasite under like conditions was only attacked in one hour to the extent of 12 77 per cent. of iron. Trials were also made in the cold, but did not differ materially from the results obtained with HCl

More important results were obtained by conducting dried hydrochloric

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* Private communication from Prof. E F Smith, [illegible].

acid gas over the minerals at an elevated temperature. In these trials, 0 3 gram of the mineral was placed in a porcelain boat and heated in a glass tube in a strong stream of the gas The sulphur in the series of experiments at the lower temperature was collected by passing the gas through bulbs containing Br + HCl, at the higher temperatures, the residue in the boat was analyzed and the sulphur lost estimated by difference. In the experiments at low temperature the entire tube was exposed to a temperature of 210°, as determined by thermometer The HCl was passed over in a strong stream for one hour The action at this temperature was slight, the results obtained do not, however, show the entire amount of sulphur removed, as some remained in the cool end of the tube, from the dissociation of the hydrogen sulphide As the action was so slight, no attempt was made to collect and estimate this sulphur remaining in the tube In the bromine and hydrochloric acid solution was found sulphur as follows

Pyrite at 210° in current of HCl (*a*)	0 94
" " " " (*b*)..................	0 93
Marcasite at 210° in current of HCl (*a*)...............	0 77
" " " " (*b*)	0 59

More marked results were obtained by increasing the temperature Similarly conducted experiments were carried out at 310° and 325°, the time of heating ranging from one to three and one half hours. The temperature of 310° was graded by keeping it between the melting points of $NaHSO_4 H_2O$ (300°) and $NaNO_3$ (313°), the higher temperature was between the last 313° and the melting point of $KClO_3$ (334°) After the HCl had been passed for a sufficient length of time, the tube was allowed to cool (with the gas current continued until cold) and then the remaining sulphur estimated by oxidizing the contents of the boat with nitric acid and potassium chlorate and precipitating and weighing as $BaSO_4$ The amount found, subtracted from 53.33 %, gave the loss of sulphur. In this case the results obtained by oxidation were reversed, the pyrite lost more sulphur than the marcasite. This is an expression of the fact that the hydrochloric acid gas (or its contained Cl) acts more vigorously on the iron of pyrite than on that of marcasite. The results of the reaction were in each case ferrous chloride in the boat and free sulphur in the tube, the latter from dissociation of the hydrogen sulphide. No ferric chloride was seen in the tube, except a trace with the pyrite. Each mineral was heated for one hour at 310° in a current of the gas and showed loss of sulphur as follows:

Pyrite heated at 310° for 1 hour in HCl, sulphur lost......	10 73
Marcasite " " " " "	7.19

About the same relative amounts were lost on heating for three and one half hours at 325°. The results thus obtained were as follows:

Pyrite heated at 325° for 3½ hours in HCl, sulphur lost....	17.13
Marcasite " " " " "	10.70

Besides these two experiments pyrite was heated for one hour at a red heat in a stream of the gas A copious sublimate of ferrous chloride was found in the tube with a trace of ferric chloride and sulphur This time the loss was 46 47 per cent of sulphur It seems evident from these experiments that as above stated the iron in pyrite is in a condition that is more readily acted on by hydrochloric acid than is the iron in marcasite It will be proved that the iron in marcasite is all ferrous while part of that in pyrite is ferric and this is probably the explanation of the above phenomenon All of the iron in each case described above would form ferrous chloride ($FeCl_2$) on account of the reducing action of the hydrogen sulphide formed Under the conditions of the above experiments the critical point developed in the oxidation of pyrite was not reached but it is not likely that it exists with this reagent or if there be a critical point it is not 21 per cent The thought suggested itself to me that perhaps some sulphur would be lost in pyrite if it were heated to 325° in a neutral atmosphere and that this might account for the difference shown in the loss of sulphur in the two minerals This proved not to be the case Pyrite heated in this way in an atmosphere of nitrogen gave no appreciable loss after one hour at a temperature of 325°

Instead of hydrochloric acid gas the action was tried of ammonium chloride at temperatures up to 335° and in an atmosphere of nitrogen Under these conditions the sulphur was combined as ammonium sulphide probably and did not exert such a reducing action on the iron These experiments were conducted as follows 0 2 gram of the finely pulverized mineral was mixed with 0 5 gram dry ammonium chloride and introduced (in a porcelain boat) into a glass tube Test samples of $NaHSO_4$ H_2O and $KClO_3$ in sealed tubes were used to regulate the temperature All air was displaced in the tube by nitrogen and a slow current of nitrogen passed through the tube before heating Under these conditions with marcasite sulphur and ammonium sulphide were found and sublimed in the tube along with ammonium chloride and in the boat there was found much ferrous chloride without any ferric chloride but in the case of the pyrite there was formed a large proportion of ferric chloride which sublimed on the tube towards the end of the operation The heating was conducted slowly in each case and continued until all ammonium chloride was sublimed from the boat, the temperature of 335° not being exceeded during this time The entire operation lasted about twenty five minutes in each case Three trials of each mineral were made and with the same result in each case, with marcasite only ferrous chloride was found in the boat and no iron in the tube, pyrite always gave much ferric chloride and little ferrous The amounts of sulphur removed are probably not very significant, they showed the following results

Pyrite heated with NH_4Cl lost sulphur	(a)	7 03
" " " "	(b)	7 10
Marcasite " " "	(a)	9 50

The important point brought out in these experiments is that pyrite contains a large amount of ferric iron, while in marcasite the iron apparently exists in the ferrous condition Some reducing action might however have taken place due to the sulphides formed The condition of the iron in the chlorides found in the boat and tube was very carefully tested by several reagents in each case and there can be no doubt as to the correctness of the results as stated above

The decomposition of the sulphides by metallic salts seemed to offer some hope of being productive of results that would show in a quantitative way the exact amounts of ferrous or ferric iron that are present in these two minerals In this line, the action of gold chloride silver nitrate and silver sulphate were tried in a qualitative way with both minerals Of these the first gave a ready decomposition with both and produced both ferrous and ferric salts in each case The silver nitrate gave a similar result Silver sulphate acted very slowly and without any definite results

The action of copper sulphate in neutral solution and under pressure was tried with very remarkable results At the ordinary temperature and pressure the solution of this salt has little effect on either mineral, and the same is true of the solution at a boiling temperature but under pressure the reaction is complete The experiment was conducted as follows 0 2 gram of the finely pulverized mineral was introduced into a stout glass tube and 50 c c of a 10 per cent solution of the salt $CuSO_4$ $5H_2O$ added the air displaced with a pinch of $NaCO_3$ and a drop or two of H_2SO_4 (dilute) and a heavy seal made on the tube The tubes containing the two minerals were heated for six hours in an autoclave to a temperature of about 200° The contents of the tubes were found to contain no traces of undecomposed mineral but there was a black, more or less flocculent precipitate in its place This proved to be copper sulphide The solution had not altered appreciably in appearance The liquid contents of the tube were in each case transferred to a flask previously filled with CO_2 and with 10 c.c. dilute sulphuric acid in the bottom, the tube then rinsed with water and the amount of ferrous iron present titrated with freshly standardized potassium permanganate In the case of marcasite this gave 18 c c $KMnO_4$ solution (this was two- or three tenths of a cubic centimeter too much, on account of the difficulty in catching the end reaction) To correct this for the iron in the copper sulphate, a blank of 50 c c. $CuSO_4$ solution, the same as used above with 10 c c dilute sulphuric acid, was titrated with the permanganate, giving 0 5 c c reduction The factor of the permanganate was 0034 gm Fe for 1 c c Making the correction for the reduction of 50 c c. $CuSO_4$ solution, this gives 47 25 per cent of iron in solution as against 46 67, the theoretical amount in FeS_2 No doubt if the end reaction had been more exact there would have been a still closer correspondence in the result.

The tube containing the pyrite was treated in exactly the same manner, and gave a reduction of permanganate of 3 8 c.c This time the end reaction was sharp and exact Calculating the above to iron (after making correction for $CuSO_4$) this gives 8 91 per cent of ferrous iron in pyrite As the total iron is 46 67 this corresponds to 19 09 per cent of the iron in the mineral or almost exactly one fifth These experiments demonstrate in a positive manner the condition of the iron in the two minerals and even show the exact amounts of each condition of the iron ferrous and ferric *

That marcasite should hence be more readily decomposed by oxidation than pyrite seems fully explained by the foregoing investigations as it consists of $Fe\ S_2$ an unsaturated compound In this compound sulphur must link to sulphur or the compound have unsaturated bonds and hence any element which would attack the sulphur would break up the compound On the other hand the iron is held to the sulphur by its full number of bonds and any substance that has an affinity for iron could not so readily attack it in this condition This would be true whether ferrous iron be considered here as Fe_2 with a valence of four or as Fe That marcasite is $Fe\ S_2$ is also indicated by its oxidation in the air into $FeSO_4$ mainly Under these same conditions it will be noted that pyrite forms both ferrous and ferric compounds as $FeSO_4$ but much more $Fe_4O_3\,(OH)_6$ and free sulphur Marcasite however when decomposed by water under pressure (in nature) forms much limonite also this being due no doubt to the oxidation being effected under pressure This constitution explains also the fact that the oxidation of marcasite is continuous and complete as shown by the current oxidations It will be shown also that this constitution of pyrite that has been made out explains fully its action with the current That marcasite is unsaturated is also indicated by the fact that it has not been made artificially or at any rate positively identified in any of the artificial FeS_2 that has thus far been made If marcasite be a persulphide as its formula would seem to indicate for a ferrous compound none of the methods detailed above for making FeS_2 would be applicable in its case unless perhaps the method of Deville might produce it All of the other methods would probably produce ferric iron at least in large part and the resulting product would be pyrite

The formula for pyrite derived from my investigations and expressing the relation of the two conditions of the iron in the simplest way is $4\,Fe^{iv}S_2$ $Fe\ S_2$ This formula is also borne out by what we know of the formation of pyrite as given in the early part of this paper and by such experiments as I have made on its decomposition as well as the fact above alluded to that it, in oxidizing in nature, does not form much ferrous compounds but mainly ferric And it also explains the fact that it is more stable as regards any element attacking its sulphur for it is most probable that all the sulphur of the $Fe''S_2$ in its formula is linked to iron I would propose the following structural formula not as expressing the exact constitution of the compound, for of that we know nothing but as an

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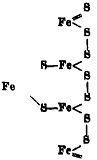
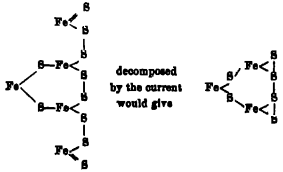
*These results have been confirmed by experiments made during the past year in this laboratory and not yet published.

expression of the condition of the iron in the molecule and as embodying in a quantitative way the result of my investigations into its constitution It will be noticed that the sulphur of the Fe S_2 is made to link entirely with iron

Structural formula of pyrite



If ferric iron be considered as Fe^{iv}—Fe^{iv} it is only necessary to connect the ferric Fe atoms with bonds but it seems to me that ferric iron is more likely Fe''' and at any rate this is the simplest way to regard it A very striking proof of the correctness of the idea expressed in this structural formula that $Fe''S_2$ in pyrite has its sulphur all linked to iron is afforded in the experiments on oxidation of the mineral by means of the electric current as detailed above It will be recalled that the amount thus oxidized was between 21 and 22 per cent Now if two molecules of FeS_2 be split off from the above formula, say those linked by sulphur to sulphur there would remain a saturated compound much more difficult to decompose (theoretically) than the pyrite molecule illustrated and the amount of sulphur thus removed would be by calculation 21 33 per cent This action could be thus illustrated



Of course this structural formula is only intended to represent the probable relations of the atoms in the molecule and the probability that the $Fe''S_2$ is entirely saturated

A structural formula for marcasite might be given as and this really expresses our entire knowledge of its constitution It may be any polymer of this, for being unsaturated it should be capable of forming polymers

I much regret that want of time has compelled me to discontinue these latter investigations into the decomposibility of these minerals by solutions of metallic salts under pressure, as it seems to open up a way for the study of many other sulphides and would doubtless be productive of most valuable results Besides this it would probably adduce additional proof of the correctness of my formulas for these minerals as given above

ACKNOWLEDGMENT

I take this occasion to express my sense of gratitude to Prof Edgar F Smith, who suggested the work to me and who by his constant encouragement and ready advice has greatly furthered its prosecution Many of the experiments were made at his suggestion, and no doubt the success of the work is largely due to him

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Notes on the Osteology of Agriochœrus Leidy (Artionyx O & W)

By W B Scott, College of New Jersey, Princeton

(Read before the American Philosophical Society, May 18, 1894)

Leidy described this genus more than forty years ago, and yet in spite of the repeated explorations of the White River and John Day beds, it has hitherto been known only from the skull In 1893, Osborn and Wortman published, under the name of *Artionyx*, an account of an extraordinary hind foot, which, with a typical artiodactyl tarsus, possesses five digits and very large claw like ungual phalanges The authors named refer *Artionyx* to the Ancylopoda on account of the resemblance of its phalanges to those of *Chalicotherium* An examination of the type specimen of the supposed new genus led me to believe that it represented the hind foot of *Agriochœrus* (see Osborn's *Rise of the Mammalia in North America*, p 44, separatim) This conclusion was founded upon the fact that the tarsus is not only artiodactyl, but characteristically oreodont in structure and that certain features of the skull and dentition of *Agriochœrus* indicated that it must be an exceedingly aberrant member of the oreodont group

Mr. J B Hatcher, curator of vertebrate paleontology in the Princeton Museum, has just sent me from the White River bad lands of South Dakota three fragmentary skeletons of *Agriochœrus*, associated with teeth, the examination of which has yielded some very surprising results. Not only is the conjecture confirmed that *Artionyx* and *Agriochœrus* are synonymous names, but also that the forelimb which I described as ? *Mesonyx dakotensis* (*Proc Acad Nat. Sci*, Phila, 1892, p 306) probably belongs to some nearly allied form *Agriochœrus* has thus almost as many synonyms as *Chalicotherium*, and as in that animal its various parts have been referred to no less than three mammalian orders, the head to the artiodactyls, the fore foot to the creodonts and the hind foot to the Ancylopoda

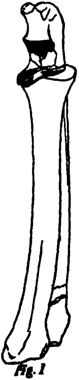

Fig. 1

FIG 1. Left ulna and radius of *A. major?* ⅔ nat. size. The ulna is too much shortened in the drawing.

These preliminary notes will deal only with some of the more salient features of structure, leaving a complete account of the skeleton for another occasion. Beside the three parts of skeletons already mentioned, the material at present available consists of the fore leg and part of manus, lacking ungual phalanges, of the specimen described as ? *Mesonyx dakotensis* (Museum No. 10492), and a second very similar specimen collected last summer by Mr Hatcher (No. 10695).

The skull of *Agriochœrus* departs very little from that of the oreodonts, even those features in which it differs from the White River members of that family, such as the open orbit and (probably) the absence of the lachrymal pit, being shared by *Protoreodon* of the Uinta Eocene.

The dentition displays the preeminently characteristic feature of the oreodonts in the conversion of the inferior canine into a functional incisor, while $\overline{\text{p 1}}$ assumes the form and function of the canine In other respects the dentition is widely different from that of the oreodonts. Briefly stated, these differences are as follows: (1) The reduction of the upper incisors; (2) the molariform pattern, more or less complete, of p. 4 in both jaws; (3) the structure of the molars, which closely resemble those of *Hyopotamus*, though lacking the protoconule in the upper series. These differences induced Leidy to refer *Agriochœrus* to a family distinct from, but allied to the oreodonts.

The proximal end of the radius is almost exactly like that of *Oreodon*; it is transversely extended, occupying the whole width of the humeral trochlea and antero posteriorly compressed. The proportions of the three humeral facets are slightly different from those of *Oreodon*, the outer one being relatively narrower and the pit for the intercondylar ridge of the humerus larger and deeper. This applies, however, only to the large species from the upper beds; in *A. antiquus* the correspondence of this portion of the radius with that of *Oreodon* is complete The shaft has a remarkably strong curvature forward (i e with the convexity in front) and is slender with transversely oval section broadening gradually to the distal end while in *Oreodon* it continues slender and expands suddenly into the inferior end The distal portion presents many more points of difference between the two genera than does the proximal and has in *Agriochaerus* quite a deceptively carnivore like appearance In the latter it is more thickened transversely and less anteroposteriorly than in *Oreodon* the scaphoid and lunar facets are less distinctly separated and of different shape and there is no sulcus for the extensor tendons upon the anterior face of the bone The ulna has an olecranon shaped much like that of *Oreodon* and similarly grooved at the extremity but decidedly thicker and more massive The inner humeral facet forms in its distal portion a remarkably prominent flaring lip far exceeding the corresponding structure in *Oreodon* The shaft is large throughout proximally it is trihedral but soon becomes much compressed laterally and resembles a rib in shape since the antero posterior depth is retained The distal end is contracted to a narrow and simply convex facet for the cuneiform

The carpus is very different from that of *Oreodon* A complete account of it cannot yet be given the only available specimens lacking the scaphoid and pisiform The lunar is more like that of the Uinta genus *Protoreodon* than that of the White River form The special peculiarity of the lunar in the true oreodonts lies in its tendency to move over upon the unciform and to make its contact with the magnum altogether lateral This tendency is already beginning in *Protoreodon* and reaches its culmination in *Merycochaerus* and *Merychyus* In *Agriochaerus*, on the other hand, this tendency is reversed, the lunar rests almost entirely upon the magnum its facet for which is broad and but slightly oblique The anterior portion of this facet is convex becoming deeply convex behind The unciform facet is lateral rather than distal in front but towards the palmar side the unciform extends beneath the lunar The radial surface is like that of *Oreodon*, but does not descend so low upon the dorsal face of the bone, and the palmar portion does not present so much laterally The cuneiform is relatively large, proximally it displays a broad concavity for the ulna, while the distal face is occupied by the large subcircular facet for the unciform The pisiform facet is flat and notably small whereas in *Oreodon* it is concave and occupies the whole palmar side of the bone The trapezium is somewhat of a surprise in its shape and connections, it

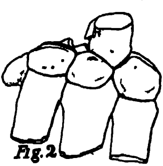

Fig. 2

Fig. 2 Part of left manus of *A major*? Nat. size The trapezium is incorrectly placed the surface in contact with the trapezoid being that for the scaphoid

is a small nodular bone, which is attached to the scaphoid and trapezoid, but has no facet for a first metacarpal. In view of the fact, indicated by Osborn and Wortman, and confirmed by one of the specimens received from Mr Hatcher, that a hallux was present in the pes, the absence of the pollex, which is preserved in at least two oreodonts, is decidedly unexpected There is reason to believe however that the pollex was retained in *A antiquus* The trapezoid is considerably larger than the magnum, especially its dorsal portion , posteriorly it is excavated on the ulnar side for the extension of the magnum The surface for the scaphoid is somewhat warped , broad and proximal in front, narrower and obliquely lateral behind. The distal portion of the trapezoid articulates only with the second metacarpal. The magnum differs from that of *Oreodon* in several important respects. Its proximal surface is occupied principally by the lunar, the scaphoid being confined to a relatively narrow surface in front, though posteriorly the contact is more considerable, and further the magnum has but a very small facet for the second metacarpal The unciform differs considerably from that of *Oreodon*. Anteriorly the lunar facet forms an excavation upon the radial side of the bone, but posteriorly an almost cylindrical process extends beneath the lunar. The proximal surface, which in *Oreodon* is divided equally between the lunar and cuneiform facets, is occupied almost entirely by the facet for the cuneiform. The articular surface for the fifth metacarpal differs from that of the last-named genus in its larger relative size and more distal position, and the posterior hook of the unciform is decidedly more massive.

The metacarpals are represented by the proximal and distal ends of the second and fourth and by the third complete. They display several significant differences from those of *Oreodon*. As already mentioned the pollex was probably entirely absent and the other metacarpals are of more uniform size, giving a more isodactyl form of manus than in *Oreodon*. The head of mc II is slightly smaller than that of mc. IV, and has a large concave facet for the trapezoid and a very minute one for the magnum. The shaft is more rounded and less antero posteriorly compressed than in *Oreodon*. The distal end is creodont rather than ungulate in appearance. This appearance is due to the great enlargement of the processes for attachment of the lateral ligaments, the more distinct constriction of the trochlea and its almost spherical shape and to the greater prominence of the carina. Mc III is the heaviest of the series ; it bears a large facet for the magnum, which is convex antero-posteriorly and concave transversely, and abuts against the unciform by a process which overlaps the head of mc. IV ; this process is, however, relatively smaller than in *Oreodon*. Mc IV requires no particular description ; it is rather smaller than mc. III and somewhat larger than mc. II.

The phalanges are, at first sight, very different from those of *Oreodon*, but a careful comparison shows important resemblances, especially if the small species, *A. antiquus*, from the lower beds be considered. In the proximal phalanx the following differences from *Oreodon* may be observed : (1)

The proximal articular surface is more deeply concave and more oblique to the long axis of the bone presenting dorsally as well as proximally (2) The distal trochlea is less depressed more deeply notched and extends farther upon the palmar side In the second phalanx the dorso palmar diameter is relatively much greater and the transverse diameter less than in *Oreodon* The median ridge of the proximal trochlea is much more prominent and the lateral concavities of this surface more deeply excavated The distal articular facet is much more extensive especially upon the palmar side and more deeply notched in the middle line The ungual is compressed and forms a large claw quite unlike the slender pointed hoof of *Oreodon* though the difference is hardly a fundamental one The facet for the second phalanx is much greater in the dorso palmar direction and allows a more extended movement of the two bones upon each other The mutual relations of the three phalanges is quite different in the two genera In *Agriochœrus* the arrangement is much like what is found in *Chalicotherium*

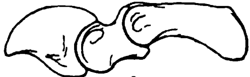
Fig 3

FIG 3 Phalanges of [illegible] digit of manus Same individual as Fig 1 and nat size

The tibia differs in several important respects from that of *Oreodon* The proximal end is carnivorous rather than ungulate in appearance This is due partly to the flatness of the condyles and their slighter obliquity from before backward but especially to the small prominence of the cnemial crest which though broad and massive is much lower than in *Oreodon* and hence the proximal portion of the tibia has a decidedly smaller antero posterior diameter than in that genus the spine is also less conspicuous The distal end is remarkable for the great size of the internal malleolus which is very long and has an articular facet for the astragalus upon its free end

The tarsus has already been fully described by Osborn and Wortman It is requisite here, therefore only to call attention to the differences which obtain between the various species of *Agriochœrus* as well as between the latter genus and *Oreodon*. In the absence of teeth it cannot yet be determined whether the specimen described by Osborn and Wortman should be referred to any of Leidy s species and therefore for the purposes of the present comparison, the name *A gaudryi* O and W will be retained *A antiquus* from the Oreodon beds differs from *A gaudryi* in the following particulars (1) The size is somewhat smaller (2) All the elements of the tarsus are relatively higher and narrower (3) There is less difference in size between the internal and external condyles of the astragalus and the latter is separated by a much wider interval from the cuboidal facet. (4) The pit for the internal malleolus is much less deeply inclsed (5) The fibular facet of the calcaneum is higher and more oblique, but less extended antero-posteriorly (6) The calcaneal facet of the cuboid is relatively broader, while that for the astragalus is narrower Unfortunately the compound cuneiform is lost from the specimens of *A antiquus* and the only navicular preserved is too much injured for comparison

The tarsus of *Agriochœrus* is fundamentally similar to that of *Oreodon*, but with many significant differences of detail. Comparing *O. culbertsoni* with *A antiquus* the following deviations in the structure of the latter may be observed (1) All the tarsal bones are much lower and broader. (2) The pit on the astragalus for the tibial malleolus is much deeper and the ridge separating the cuboid and navicular facet of this bone is decidedly more prominent (3) The sustentaculum of the calcaneum is much more strongly developed and projecting. (4) The calcaneal facet descends lower upon the dorsal face of the cuboid; the hook-like process on the plantar surface of the cuboid is very much more massive and the distal facet for the fifth metatarsal less distinctly separated from that for the fourth In *A. gaudryi* the plantar hook of the navicular is greatly increased in breadth as compared with that of *O culbertsoni*, and on the distal surface of the compound cuneiform the facets for the second and third metatarsals lie in the same transverse plane, instead of being at different levels. In consequence of this arrangement the second metatarsal, which in *Oreodon* abuts against the tibial side of the ectocuneiform, is entirely excluded from that element Whether the same is true of *A antiquus* cannot at present be determined. In one of the specimens of the latter species the entocuneiform is preserved It is considerably wider than the same bone in *Oreodon*, and has a distal facet for the first metatarsal, thus confirming Osborn and Wortman's observation as to the presence of a hallux in this genus. A number of caudal vertebræ show that *Agriochœrus* had a longer and more powerful tail than *Oreodon*; indeed, the tail is quite as well developed as in the larger cats, *e. g.*, the leopard. I have elsewhere called attention to the curious character of the axis in this genus (*Morphologisches Jahrbuch*, Bd xvi, p. 361). The odontoid process has the characteristic shape found in the oreodonts; it is short and broad, with strongly convex ventral surface, nearly flat dorsal surface, and rounded anterior margin. This process is, therefore, neither conical nor spout-shaped, but intermediate between the two. The neural spine, on the other hand, is entirely different from that of the oreodonts and forms a great hatchet-shaped plate, resembling carnivorous rather than ungulate structure.

THE SYSTEMATIC POSITION OF AGRIOCHŒRUS.

Leidy separated this genus from the oreodonts, as the type of a distinct family, which he regards as a "peculiar and extinct family of ruminants of the most aberrant character, but allied to the *Oreodonts*." Gill united the two families, giving to *Agriochœrus* subfamily rank, an example which was followed by Cope and by myself. Osborn and Wortman referred their genus *Artionyx* to the Ancylopoda with *Chalicotherium*, constructing a new suborder the Artionychia for its reception. While much remains to be learned regarding *Agriochœrus* some inferences from the facts of structure described in the preceding pages are reasonably clear. In the first place I cannot agree with Osborn and Wortman in removing this genus altogether from the Artiodactyla and assigning it to the Ancylopoda. Such a removal implies that all of the artiodactyl features of structure have been independently acquired and this is highly improbable. I have it is true repeatedly insisted upon the reality and frequency of parallelism in development but it is very easy to push this doctrine to unwarranted extremes. Among mammals at least no such extreme case of this mode of evolution is known as would include the skull dentition limbs carpus and tarsus and in fact everything but the phalanges. The only evidence which could justify such a conclusion would be the finding of a succession of species by which the independent origin of the two groups could be traced out step by step. The agreement of *Agriochœrus* with *Chalicotherium* is of the slightest and most superficial character consisting only in the fact that both genera have claws. But the ungual phalanges are of a very different pattern in the two genera and it is surely the less dangerous horn of the dilemma to conclude that this single correspondence is due to parallelism rather than that the numerous and important characters in which *Agriochœrus* agrees with the artiodactyls are the result of such a process.

But a difficulty arises here. Is not the distinction between hoof and claw a fundamental one established long before the artiodactyls had arisen? To answer this question with any certainty would require a much more exact knowledge of the genesis of both kinds of phalanx than we at present possess but there is much reason to believe that while the ungulate and unguiculate types of mammals are radically distinct yet the distinction does not rest, as the names imply, upon the character of the ungual. At all events both hoof and claw are found in closely allied genera as for example among the rodents creodonts and edentates. These examples are it is true, all found among the unguiculates but there is no *a priori* reason for assuming that a similar diversity among the ungulates may not occur. That it is rare in the latter group is doubtless due to the fact that ungulates almost uniformly employ the feet only for purposes of locomotion and indeed it is difficult to conjecture what the function of such feet as those of *Agriochœrus* and *Chalicotherium* may have been. In view of all the characteristic artiodactyl structures which *Agriochœrus* displays one can hardly escape the conclusion that in this case the transition from hoof to claw has actually taken place and that this genus is the culmination of a series of aberrant artiodactyls. In the second place it is obvious that Leidy's separation of *Agriochœrus* from the *Oreodontidæ* is entirely proper. A more obscure problem is to determine the relationship between the two families, and to this end it will be necessary to briefly recapitulate their resemblances and differences *Agriochærus* resembles the oreodonts in the following points: (1) The skull structure of the two families is closely alike and the Uinta genus *Protoreodon* hardly differs at all in this respect from *Agriochærus* (2) The very characteristic oreodont features of the caniniform first lower premolar and incisiform canine are repeated in *Agriochærus* (3) The atlas and the peculiar odontoid process of the axis are similar in both groups (4) The elbow joint in the oreodonts is, as is well known, very exceptional among ungulates and all its peculiarities are repeated in somewhat exaggerated form in *Agriochærus*. (5) The tarsus is oreodont in almost every particular, and is curiously paralleled in many details by that of the Loup Fork genus *Merycochærus*. It should be remembered in this connection that in *A antiquus* the tarsus deviates less from the oreodont type than does that of the later and larger *A gaudryi*, and is in fact intermediate between the two. This is significant, because in the long continued existence of the *Oreodontidæ* from the Uinta to the Loup Fork, there is relatively little change in the tarsus, while each successive genus displays its own particular modification of the carpus (6) The phalanges, except the unguals, differ relatively little in the two groups and are manifestly of the same type. (7) The articulations of the metapodials are similar.

The most important respects in which *Agriochærus* differs from the oreodonts are as follows (1) The pattern of the molar teeth is very distinct, but this gap, especially as regards the lower teeth, is to some extent bridged by *Protoreodon* of the Uinta Eocene, which shows that the two kinds of molar may well have been derived from a single type. (2) The distal end of the radius is creodont, rather than ungulate in character. (3) In *Agriochærus* the carpus differs decidedly from that of the White River oreodonts, both in the shape and in the connections of its parts, the displacement being in opposite directions. Here again *Protoreodon* tends to connect the two extremes and displays a type of carpus not far removed from that which may have given rise to both. (4) The position of the phalanges with reference to the metapodials and to each other is quite different. (5) Much the most remarkable difference between the two groups is the presence of claws in *Agriochærus*, while the oredonts have hoofs. (6) Though the large *Agriochærus* species from the uppermost White River beds has no pollex, there is reason to believe that it was present in the earlier and smaller *A. antiquus*. (7) A striking difference in the knee-joint is observable between *Agriochærus* and the oreodonts, which indicates that in the former the leg was straighter, while the proximal end of the tibia and distal end of the femur have quite the appearance of the same parts in the Carnivora. (8) All the elements of the tarsus are lower and broader, the astragalus has a deep pit for the internal malleolus and a hallux is present. The latter has not been found in any oreodont. (9) Another carnivorous feature in *Agriochærus* is the shape assumed by the neural spine of the axis.

In brief, the dentition and skeleton of *Agriochærus* show a large number of close correspondences with the oreodonts and especially in those particulars in which that group differs from other artiodactyl families On the other hand there are significant deviations from the oreodonts which are to be found more particularly in the structures correlated with the curious change in foot structure It seems on the whole highly probable that the two families are not distantly related especially if the somewhat intermediate character of *Protoreodon* be considered

The conclusion to which the available evidence leads is then that *Agriochœrus* is the last term in a succession of species which form a curiously specialized offshoot of the *Oreodontidæ* its divergences from that family being principally the results of a change in the functions and uses of the feet The separation of the two series was probably already established in the Uinta Eocene for in spite of its somewhat intermediate character *Protoreodon* can be a forerunner only of the oreodonts The Bridger beds may be expected to yield the common ancestor of the two series and this animal will probably turn out to be a pentadactyl form with buno selenodont dentition and quinquetuberculate upper molars the unpaired lobe in the anterior half of the crown As I have elsewhere suggested this hypothetical form may have been already found in the imperfectly known *Helohyus*

The likeness of the *Agriochœrus* molars to those of *Hyopotamus* has often been noticed and the inference drawn that these two genera were in some manner more or less closely related Mr Hatcher writes me that he has lately found feet of *Hyopotamus* which suggest the same affinities Until this material has been carefully studied it will be the part of prudence not to prejudge the question

Three New Methods for the Detection of Forgery

By Dr Persifor Frazer

(Read before the American Philosophical Society May 18 1894)

I wish to put on record three new methods which I have applied successfully for the purpose of detecting frauds in written documents

The first enables one to determine with comparative ease which of two crossing ink lines was made first, and consists in observing the crossing by a lens of low power (four or five diameters) at a very oblique angle If a light ink line be made over a darker one the appearance to the eye when viewing the crossing perpendicularly to the plane of the paper will be that the darker line is superposed The reason of this is that ink lines are quite transparent and the darker line is seen through the lighter one and seems to make one continuous line with its two limbs across the intersection When the paper is inclined however but few of the rays of light which reach the eye by reflexion from the intersection traverse and lose rays by absorption from both ink films but the greater number penetrate only the upper ink and do not suffer absorption by the lower

The second is a method of judging whether or not two lines have been made with the same ink and consists in passing over each in succession prisms of red yellow or blue glass (or two of these) and noting the number of millimeters through which it is necessary to move each prism from the position where its thin edge is in contact with the mark to be judged to that where the color is extinguished and the line is black The prism is pushed horizontally over the ink mark continually adding to the thickness of the colored glass over the latter When the line appears quite black the distance in mm over which the prism has been pushed is read off and compared with the number of mm which the other line requires to attain the same result If the inks have the same colors these results must agree

Third method In 1896 I read before the Society a paper on the use of composite photography for the purpose of establishing the type of an individual s writing and especially the signature Since then the mechanical difficulties in the way have been greatly lessened and the method has given most valuable results in cases before various courts But there are many occasions where it cannot be employed for one reason or another and in such cases I have devised a system of measurement and tabulation which accomplishes by figures what composite photography established automatically by form The older method may be called the graphic average of the handwriting and the later the numerical average The advantage of the former is that it takes into account at once *all* the elements of character while the latter can deal only with comparatively few but in spite of this the results attained have been very interesting

By the system here alluded to a given number of heights breadths and angles of letters and spaces between them and between words are selected and measured in a large number of undisputed signatures The same elements are then measured in the signature in dispute The averages of all the elements in the genuine series is then compared with the latter and their agreement or disagreement will generally lead to a correct judgment as to the genuineness of the disputed signature

This method has given successful results in a direction which extends the original idea to a study of guided hands and it has been possible to extract from the columns of measurements, proofs of the existence of characteristics of each of the separate handwritings

Stated Meeting, May 4, 1894.

Mr. INGHAM in the Chair.

Minutes of preceding meeting read.

Letters of envoy were received from the Survey of India Department, Calcutta; K. Sachsische Gesellschaft der Wissenschaften, Leipzig, Saxony; Faculté des Sciences, Marseilles, France; Mrs. Carvill Lewis, London, Eng.

Letters of acknowledgment were received from the Royal Society of New South Wales, Sydney (142); Imperial Academy of Sciences, Physical Central Observatory, Russian Chemical Society, Library of the Ministry of Marine, Prof. Serge Nikitin, St Petersburg, Russia (142), K. Vetenskaps Akademiens Bibleotek, Statistika Central Byran, Stockholm, Sweden (142); Maatschappij van Nederlandsche Letterkunde, Leiden, Z. Holland (142); Bibliotheque R. de Belgique, Bruxelles (140, 141); Redaction der *Naturwissenschaftlichen Wochenschrift*, Berlin, Prussia (141); R. Accademia dei Lincei, Rome, Italy (142); Bibliothèque Universitaire, Lyon, France (130–135); Mercantile Library, Philadelphia (135); Mr. Everard F. im Thurn, Georgetown, British Guiana (141).

Letters of acknowledgment (144) were received from the Engineers' Club, Franklin Institute, University of Pennsylvania, Mercantile Library, Pennsylvania Historical Society, Free Library of Philadelphia, Academy of Natural Sciences, Wagner Free Institute, Numismatic and Antiquarian Society, Gen. I. J. Wistar, Admiral Macauley, Profs. E. D. Cope, H. D. Gregory, Lewis M. Haupt, H. V. Hilprecht, J. P. Lesley, James MacAlister, Drs. John Ashhurst, Jr., J. Solis Cohen, Persifor Fraser, W. W. Keen, Morris Longstreth, John Marshall, Charles A. Oliver, C. N. Peirce, W. S. W. Ruschenberger, H. Clay Trumbull, W. H. Wahl, Messrs. R. L. Ashhurst, R. Meade Bache, Patterson DuBois, Jacob B. Eckfeldt, Robert P. Field, E. V. d'Invillier, W. W. Jefferis, Franklin Platt, Theodore D. Rand, Louis Vossion, J. M. Wilson, Ellis Yarnall, Philadelphia; Mr. Heber S. Thompson, Pottsville, Pa.; Rev. F.

A. Muhlenberg, Reading, Pa.; Rev. G. W. Anderson, Rosemont, Pa.; Dr. W. H. Appleton, Swarthmore, Pa.; Dr. John Curwen, Warren, Pa.; Mr. Philip P. Sharples, West Chester, Pa.; Wyoming Historical and Geological Society, Wilkesbarre, Pa.; Maryland Institute for the Promotion of the Mechanic Arts, Enoch Pratt Free Library, Baltimore, Md.; Journal of the U. S. Artillery, Fortress Monroe, Va.; Mr. Jedediah Hotchkiss, Staunton, Va.; Leander McCormick Observatory, Library of the University of Virginia, Prof. J. W. Mallet, University of Virginia; Agricultural Experiment Station, Experiment, Ga.; Georgia Historical Society, Savannah; Michigan State Library, Lansing; Athenæum, Columbus, Tenn.; Dr. Robert Peter, Lexington, Ky.; Prof. E. W. Claypole, Akron, O.; University of Cincinnati, Society of Natural History, Cincinnati Observatory, Cincinnati, O.; Oberlin College, Oberlin, O.; Purdue Experiment Station, La Fayette, Ind.; Prof. G. W. Hough, Evanston, Ill.; State Historical Society of Wisconsin, Wisconsin Academy of Science, Arts and Letters, Madison.

Accessions to the Library were reported from Prof. N. A. Cobb, Sydney, Australia; Great Trigonometrical Survey of India, Dehra Dun; Etat Independant du Congo, Brussels, Belgium; Musée Naturelle de Hongrie, Budapest; K. Akademie der Wissenschaften, Vienna, Austria; Gesellschaft für Anthropologie, Ethnologie und Urgeschichte, Berlin, Prussia; Naturwissenschaftliche Verein, Bremen, Germany; Schlesische Botanische Tausch-Verein, Breslau, Prussia; Prof. August Tischner, Leipzig, Saxony; Geographische Gesellschaft, Bern, Switzerland; Société Vaudoise des Sciences Naturelles, Lausanne, Switzerland; Société Francaise de Physique, Paris, France; Mrs. Carvill Lewis, London, Eng.; Geological Society, Glasgow, Scotland; Canadian Institute, Toronto, Canada; American Statistical Association, Prof. Alexander Macfarlane, Boston, Mass.; Prof. C. L. Doolittle, Salem, Mass.; Agricultural Experiment Station, Newark, N. J.; Academy of Natural Sciences, Mercantile Library, Mr. Frederick Prime, Philadelphia; Office of the Chief of Engineers, U. S. Department of Agriculture, Anthropological Society, U. S. Fish Commission, Census Office, Washington, D. C.; Lick Observatory, Mt. Hamilton, Cal.; Iowa Masonic Library, Cedar Rapids; Geological Survey, Des Moines, Ia.; Deutsche Wissenschaftliche Verein, Santiago de Chile, Sociedad de Ingenieros, Puebla, Mex.

Mr. Henry Carey Baird, in the following letter, presented to the Society, on behalf of the contributors, a handsome portrait of George Ord, a former Vice-President of the Society:

TO THE PRESIDENT OF THE AMERICAN PHILOSOPHICAL SOCIETY

Mr. President:—The pleasant duty has devolved on me, on behalf of a number of members of the Society, subscribers, of presenting to the Society a portrait of the late George Ord

This portrait has been copied by Mr. T. Henry Smith from the original by John Nagle, painted in 1829, the property of the Academy of Natural Sciences, to the courtesy of the officers of which institution we are indebted for permission to make this copy

Mr. Ord was an eminent Philadelphian, having been born here in 1781, and died here January 24, 1866. He was elected a member of this Society October 17, 1817, was Secretary 1820–1827 and also in 1829, Vice President 1832–1835, Librarian 1842–1848, Treasurer 1842–1847, Councilor 1836. From 1851 to 1858 he was President of the Academy of Natural Sciences. He was also a fellow of the Linnean Society of London.

He was an intimate friend of the naturalist Alexander Wilson, and was his companion in many of his ornithological expeditions. After Wilson's death, in 1813, Mr. Ord completed the eighth volume of Wilson's *Ornithology* (Philadelphia, 1814) In 1825 he prepared a new edition of the last three volumes, and in 1828 published his *Life of Wilson*. In 1834 he wrote the *Memoirs of Thomas Say*, and in 1849 a *Memoir of Charles A. Lesueur*. While his special department was that of natural history and especially ornithology, his labors as a lexicographer were important, having aided in editing Johnson's Dictionary, and having contributed valuable matter to the dictionary of Noah Webster.

It seems eminently fitting that a portrait of this distinguished member of the Society should adorn the walls of its hall, and it is hoped that this faithful reproduction of Nagle's admirable picture may be thought worthy of the subject.

PHILADELPHIA, May 4, 1894. HENRY CAREY BAIRD.

The letter was ordered spread on the minutes with the list of donors.

Dr. Morris moved a vote of thanks to the donors, which was adopted.

Committees on "Membership" and the "Memorial Dinner" reported progress.

A letter was received from Mr. Ben. D. Peter, Lexington, Ky., announcing the death of his father, Dr. Robert Peter, April 26, 1894, æt. 89.

Obituary notice of George de Benneville Keim was read by Dr. Brinton.

Mr. Bache read his views on "The Dynamics of Boxing."

Nomination No. 1278 was read.

Mr. Prime moved and Dr. Brinton seconded the following resolution:

Resolved, That J. Sergeant Price, the Treasurer of the American Philosophical Society, is hereby authorized and directed to cast the vote to which the corporation is entitled as a policy holder and contributor of "The Philadelphia Contributionship for the Insurance of Houses from Loss by Fire," at any election for Directors and Treasurer of the corporation last named, to serve for the year ending the second Monday of April, 1895, and to vote on any questions that may arise at the meeting at which the said election is held.

The resolution was unanimously adopted.

And the Society was adjourned by the presiding member.

Stated Meeting, May 18, 1894.

President FRALEY in the Chair.

Col. Henry DuPont, a newly elected member, was presented to the Chair, and took his seat.

Minutes of meeting May 4th read.

Correspondence was submitted as follows:

Letters of envoy were received from the Institut Egyptien, Cairo; Geological Survey of India, Calcutta; K. K. Astronomisch-meteorologische Observatorium, Triest, Austria; Université de Lyon, Lyon, France; Royal Statistical Society, London, Eng.; Direction Générale de Statistique, La Plata, S. A.

Letters of acknowledgment were received from the Royal Mint, Melbourne, Australia (139, 140); Académie Hongroise des Sciences, Budapest (135, 136, 137); Schweizerische Naturforschende Gesellschaft, Bern, Switzerland (142); Prof. Giovanni Capellini, Bologna, Italy (142), R. Academia di Scienze, Lettere ed Arti, Padua, Italy (142); Université de Lyon, Lyon, France (130–139, 141).

Letters of acknowledgment (144) were received from the Geological Survey Department, Dr. Alfred R. C. Selwyn, Ottawa, Canada; Literary and Historical Society, Laval University, Hon. J. M. LeMoine, Quebec, Canada; Canadian Institute, Toronto; Society of Natural History, Portland, Me.; Dartmouth College, Prof. Charles H. Hitchcock, Hanover, N. H.; Vermont Historical Society, Montpelier; Rhode Island Historical Society, Providence; Franklin Society, Providence, R. I.; Boston Society of Natural History, Massachusetts Historical Society, Public Library, Mr. Robert C. Winthrop, Boston, Mass.; Museum of Comparative Zöology, Mr. Robert N. Toppan, Prof. J. D. Whitney, Dr. Justin Winsor, Cambridge, Mass.; Free Public Library, New Bedford, Mass.; Essex Institute, Salem, Mass.; American Antiquarian Society, Worcester, Mass.; Mr. George F. Dunning, Farmington, Conn.; Connecticut Historical Society, Hartford; Yale University, Profs. O. C. Marsh, W. D. Whitney, New Haven, Conn.; Agricultural Experiment Station, Storrs, Conn.; State Library, Prof. James Hall, Albany, N. Y.; Buffalo Library, Buffalo, N. Y.; Prof. Edward North, Clinton, N. Y.; Prof. J. M. Hart, Ithaca, N. Y.; Columbia College, N. Y. Academy of Medicine, N. Y. Historical Society, American Museum of Natural History, N. Y. Hospital Library, Prof. Joel A. Allen, Hon. Charles P. Daly, Dr. Daniel Draper, New York, N. Y.; Vassar Brothers' Institute, Poughkeepsie, N. Y.; Geological Society of America, Rochester, N. Y.; Prof. W. Le Conte Stevens, Troy, N. Y.; Oneida Historical Society, Utica, N. Y.; Free Public Library, Jersey City, N. J.; Prof. Robert W.

Rogers, Madison, N. J.; New Jersey Historical Society, Newark, N. J.; Profs. W. Henry Green, Charles W. Shields, C. A. Young, Princeton, N. J.; Dr. Charles B. Dudley, Altoona, Pa.; Dr. Robert H. Alison, Ardmore, Pa.; Prof. M. H. Boyè, Coopersburg, Pa.; Hon. Eckley B. Coxe, Drifton, Pa.; Dr. Traill Green, Prof. J. W. Moore, Rev. Thomas C. Porter, Easton, Pa, Mr. Andrew S. McCreath, Harrisburg, Pa.; Haverford College, Prof. Lyman B. Hall, Haverford, Pa.; Mr. John Fulton, Johnstown, Pa.; Linnean Society, Lancaster, Pa.; Prof. F. A. Genth, Jr., Lansdowne, Pa.; Mr. P. F. Rothermel, Linfield, Pa.; Hon. James T. Mitchell, Prof. Albert A. Smyth, Philadelphia; Philosophical Society, West Chester, Pa., Col. H. A. DuPont, Wilmington, Del.; U. S. Geological Survey, Surgeon-General's Office, U. S. Coast and Geodetic Survey, Smithsonian Institution, Catholic University, U. S. Weather Bureau, Drs. J. S. Billings, W. J. Hoffman, Col. Garrick Mallery, Prof. Charles A. Schott, Mr. William B. Taylor, Washington, D. C.; University of Tennessee, Knoxville · Texas Academy of Science, Austin; University of California, Prof. Joseph Le Conte, Berkeley, Cal.; Lick Observatory, Mt. Hamilton, Cal.; Prof. George Davidson, San Francisco, Cal.; Academy of Natural Sciences, Davenport, Ia.; State Historical Society, Iowa City, Ia.; Kansas University Quarterly, Lawrence; Nebraska State Historical Society, Agricultural Experiment Station, Lincoln, Neb.; State Agricultural College, Fort Collins, Colo.; Academy of Science, Tacoma, Wash.; University of Wyoming, Laramie; College of Agriculture, Las Cruces, New Mexico.

Letters of acknowledgment for Certificate of Membership were received from Dr. Samuel A. Green, Boston, Mass.; Prof. J. M. Hoppin, New Haven, Conn.; Gen. Isaac J. Wistar, Philadelphia.

Accessions to the Library were reported from the Geological Survey of India, Calcutta; R. Accademia degli Agiati, Roveredo, Tyrol; Osservatorio Astronomico Meteorologico, Triest, Illyria; Université de Lyon, France; Société de Géographie, Toulouse, France; Royal Institution, London, Eng.;

American Oriental Society, New Haven, Conn.; Historical Society, Buffalo, N. Y.; Oneida Historical Society, Utica, N. Y.; Zoölogical Society, Editor of the *Naturalist's Leisure Hour*, Indian Rights' Association, Editors of the *International Journal of Ethics*, Prof. E. D. Cope, Dr. Charles A. Oliver, Philadelphia; University of Michigan, Ann Arbor; Observatorio Meteorologico Central de Xalapa, Mexico; Bureau d'Exchanges Internationaux de Publications de la Republique Oriental de l'Uruguay, Montevideo; Agricultural Experiment Stations, Fayetteville, Ark.; La Fayette, Ind.; Brookings, S. Dak.; Tucson, Ariz.

A photograph was received from the Yorkshire Geological and Polytechnic Society, Halifax, Eng., of Mr. James W. Davis, Honorary Secretary.

Council met, and adjourned without business.

The President appointed Dr. Ruschenberger, who accepted, to prepare an obituary of Dr. W. V. Keating.

Mr. Price moved, and Dr. Ruschenberger seconded the motion, to postpone the election of members until next regular time for election, on account of small attendance owing to very stormy weather.

Mr. Lyman read his paper on "Some New Red Horizons."

Dr. Frazer followed with remarks on his own work in the same horizons as illustrated in Adams, York, Lancaster and Cumberland counties in the State.

Prof. Cope read by title a paper from Prof. Scott entitled "Notes on the Osteology of *Agriochœrus* Leidy;" also a paper entitled "On the Lungs of the Ophidia," by himself.

Prof. Barker read a communication entitled, "Comparative Study of the Chemical Behavior of Pyrite and Marcasite," by Amos Peaslee Brown.

Dr. Frazer indicated his method of detecting forgeries in documents and handwriting.

And the meeting was adjourned by the President.

PROCEEDINGS

OF THE

AMERICAN PHILOSOPHICAL SOCIETY

HELD AT PHILADELPHIA FOR PROMOTING USEFUL KNOWLEDGE

VOL XXXIII JULY TO DECEMBER 1894 No 146

Stated Meeting September 7 1894

President Mr FRALEY in the Chair

The death of Lord Coleridge, Chief Justice of England was announced

Mr Lyman read the following correction of a statement made by Dr Frazer in the last number of the Proceedings

> In the last issue of the Proceedings Vol xxxiii p 216 for our last meeting May 18 1894 Dr Persifor Frazer makes public a wholly mistaken impression in regard to my position and influence in the State Geological Survey So far from being its quasi director I have never even had the honor of being strictly speaking a regularly employed salaried Assistant Geologist of the Survey but have only done contract work for it and have never had anything whatever to do directly or indirectly by authority or by advice in responsibility or in consultation with the management or control of any part of the work of the Survey except my own
>
> In writing out his remarks he must have believed he had uttered them essentially as they are printed but anything in the least like so inexact a statement in that matter would have been corrected at once
>
> BENJ SMITH LYMAN

Mr Prime spoke of the gold regions of South Africa

Pending nominations 1273, 1274, 1276 to 1301 (inclusive) were read

And the Society was adjourned by the President

Stated Meeting, September 21, 1894.

President, Mr. FRALEY, in the Chair.

Correspondence was submitted as follows:

Letters acknowledging the receipt of diploma from Dr Isaac Roberts, Crowborough, Sussex, England, and Hon. Robert E. Pattison, Harrisburg, Pennsylvania.

A circular from the Royal Society of New South Wales, Sydney, in reference to prizes for 1894, 1895 and 1896.

A circular from the Palæographical Society of Australasia, Sydney, setting forth the objects of the Society.

Communication from the Council of the Imperial Russian Geographical Society, in reference to the necessity of an International Agreement with regard to the publication of material contained in Naval Meteorological Journals.

Circular from the Secrétariat Général de la Société de Géographie de Toulouse, in reference to a decimal division of the day.

Prospectus of the nature and objects of the Royal Institution of Great Britain, London, England.

A letter from N. Borovko, Odessa, Russia, in reference to the question of an international language.

Letters of envoy were received from the Royal Society of New South Wales, Sydney; Mr. Edward Cousel, Melbourne, Australia; Geological Survey of India, Calcutta; Government Astronomer, Madras, India; Société Imp. Mineralogique, Comité Geologique, Observatoire Physique Central, St. Petersburg, Russia; Academia Romania, Bukarest; Universite R. de Norvège, Christiania; Fondation de P. Teyler van der Hulst, Hárlem, N. Holland; Maatschappif der Nederlandsche Letterkunde, Leiden, Z. Holland; K. Leopoldinisch-Carolinische Deutsche Akademie der Naturforscher, Halle a. S., Prussia; Gesellschaft zur Beförderung der gesammten Naturwissenschaften, Marburg, Prussia; Würtembergische Verein für Handelsgeographie, Stuttgart; Musée Guimet, Bureau of Longitudes, Société Philologique, Paris, France; Zoölogical

Society, Royal Society, London Eng , Royal Dublin Society, Royal Irish Academy Dublin Ireland , Geological Society of America, Rochester, N Y , U S Naval Institute, Annapolis, Md , Museo de La Plata, La Plata, Argentine Republic, S A , Société Scientifica du Chili, Santiago, Instituto Fisico Geografico Nacional, San José Central America

Letters of acknowledgment were received from the Tokyo Library, Tokyo, Japan (139 140, 141), Linnean Society of N S Wales, Sydney (141), R Geographical Society (Queensland Branch), Brisbane Queensland (141) Mr Samuel Davenport, Adelaide S Australia (141), Royal Society of Victoria, Melbourne (141), Public Library, Wellington, N Z (137, 138, 141), Societas pro Fauna et Flora Fennica Helsingfors Finland (142), Physico Mathematical Society, Kasan, Russia (140, 141, 142), Tashkent Observatory, Tashkent, Russia (142), Prof Dr Japetus Steenstrup Copenhagen, Denmark (142), Biblioteca N C, Firenze, Italia (142), R Istituto Lombardo di Scienze e Lettere, Milan, Italy (142), R Accademia d Scienze Lettere ed Arti, Modena Italy (142) Società Africana d Italia Naples Italy (142), Prof Giuseppe Sergi, Roma, Italia (142), R Osservatorio dell Università, Turin, Italy (142), Marquis Antonio de Gregorio, Palermo, Sicily (141), Société R de Geographie, Anvers, Belgique (138, 142), R Accademia degli Agiati, Rovereto Tyrol (139, 140, 141), Gesellschaft fur Erdkunde, Berlin, Prussia (142), Naturhistorische Verein, Bonn (141), Naturwissenschaftliche Verein, Bremen, Germany (141), Naturforschende Gesellschaft, Emden, Prussia (141), Naturhistorische Gesellschaft, Hannover, Prussia (139, 141), K Sternwarte, Leipzig, Saxony (141), Verein der Freunde der Naturgeschichte, Mecklenburg, Germany (141), K Sternwarte, Munich, Bavaria (142), Naturwissenschaftliche Verein, Osnabrück, Prussia (141, 142), Bibliothèque Cantonale, Lausanne, Switzerland (142), Academia des Sciences et Belles Lettres, Angers, France (141), Société Linneenne, Bordeaux (142), Société d'Histoire et d'Archæologie, Chalon sur Saone, France (142), Société des Sciences Naturelles et Archéologiques de la Creuse, Guéret, France (142); Bibliothèque Universitaire, Lyon, France (142); Faculté des Sciences, Marseille, France (114, 115, 116, and Catalogue, Parts i–iv); Société Francaise de Physique, Société de l'Histoire de France (144), Rédaction de "Cosmos" (142, 144), Ministre des Travaux Publics (138, 141), Compte de Charencey, M. Victor Duruy (144), Profs. E. Levasseur (142), E. Mascart (142, 144), Gaston Maspero (142, 144), Léon de Rosny (142), Marquis de Nadaillac (142), Paris, France.

Letters of acknowledgment (145) were received from Mr. Horatio Hale, Clinton, Ontario; Bowdoin College Library, Brunswick, Me.; Society of Natural History, Portland, Me., Amherst College Library, Amherst, Mass; Massachusetts Historical Society, Athenæum, Boston Society of Natural History, State Library of Massachusetts, Boston Public Library, Mr. Robert C. Winthrop, Boston, Mass.; Museum of Comparative Zoology, Profs. Alexander Agassiz, George L. Goodale, Mr. Robert N. Toppan, Dr. Justin Winsor, Cambridge, Mass.; Essex Institute, Salem, Mass.; Marine Biological Laboratory, Woods Hole, Mass.; American Antiquarian Society, Worcester, Mass.; Rhode Island Historical Society, Providence; Mr. George F. Dunning, Farmington, Conn.; Connecticut Historical Society, Hartford; Prof. O. C. Marsh, New Haven, Conn.; New York Historical Society, Meteorological Observatory, American Museum of Natural History, New York Hospital, Columbia College, Academy of Sciences, Hon. Charles P. Daly, Capt. R. Somers Hayes, Profs. Joel A. Allen, John J. Stevenson, New York, N. Y.; Prof. James Hale, Albany, N. Y.; Buffalo Library, Buffalo, N. Y.; Prof. Edward North, Clinton, N. Y.; Profs. J. M. Hart, Burt G. Wilder, Ithaca, N. Y.; Prof. W. Le Conte Stevens, Troy, N. Y.; Academy of Science, Rochester, N. Y.; Vassar Brothers' Institute, Poughkeepsie, N. Y.; Dr. W. T. Barnard, Boonton, N. J.; Free Public Library, Jersey City, N. J.; New Jersey Historical Society, Newark; Prof. W. Henry Green, Princeton, N. J.; Prof. Martin H. Boyé, Coopersburg, Pa.; Hon. Eckley B. Coxe, Drifton, Pa.; Rev. Thomas C. Porter, Prof. J. W. Moore, Dr. Traill Green, Easton, Pa.; Mr. John

Fulton, Johnstown, Pa ; Linnean Society, Lancaster, Pa ; Dr. D. G. Brinton, Media, Pa.; Academy of Natural Sciences, Engineers' Club, Historical Society of Pennsylvania, Mercantile Library, Wagner Free Institute, Numismatic and Antiquarian Society, Editor of *The Medical News*, Public Library, Library Company of Philadelphia, Hon. James T. Mitchell, Gen. I. J. Wistar, Revs. W. H. Furness, H. Clay Trumbull, Profs John Ashhurst, Jr., Edward D. Cope, F. A. Genth, Jr., Lewis M. Haupt, H. W. Spangler, Drs. George Friebis, Morris Longstreth, Charles A. Oliver, C. N. Peirce, W. S. W. Ruschenberger, Charles Schaffer, William Thomson, Messrs. Richard L. Ashhurst, R. Meade Bache, Cadwalader Biddle, Lorin Blodget, Patterson DuBois, Jacob B. Eckfeldt, William A. Ingham, E. V. d'Invilliers, A. S Letchworth, Robert Patterson, Henry Phillips, Jr., Franklin Platt, Theodore D. Rand, L. A. Scott, N. P. Tatham, Louis Vossion, Mrs. Helen Abbott Michael, Philadelphia; Prof. John F. Carll, Pleasantville, Pa.; Mr. Heber S. Thompson, Pottsville, Pa.; Dr. W. H. Appleton, Swarthmore, Pa.; Rev. F A. Muhlenberg, Reading, Pa.; Philosophical Society, Hon. William Butler, Mr. Philip P. Sharples, West Chester, Pa.; Wyoming Historical and Geological Society, Wilkesbarre, Pa.

Accessions to the Library were reported from the Royal Society of New South Wales, Mr. N. A. Cobb, Sydney, Australia; Royal Geographical Society of Australasia, Melbourne; New Zealand Institute, Wellington; Geographical Society, Tokyo Library, Tokyo, Japan; Government Observatory, Madras, India; Société Phys.-Mathématique, Kasan, Russia; Société des Naturalistes de la Nouvelle Russie, Odessa; K. K. Mineralogische Gesellschaft, Comité Geologique, Physikalische Central Observatoriums, St. Petersburg, Russia; Bataviaasche Genootschap van Kunsten en Wetenschappen, Batavia, Java; K. Bibliotheek, K. Zoologisch Botanische Genootschap, 'S Gravenhage, Holland; Société Hollandaise des Sciences, Musée Teyler, Haarlem, Holland; Friesch Genootschap voor Geschied. Oudheid en Taalkunde, Leeuwarden, Friesland; Maatschappij der Nederlandsche Letterkunde, Holland;

Société Batave de Philosophie Expérimentale, Rotterdam, Holland; Naturforschende Verein, Brunn, Austria; Siebenbürgische Verein fur Naturwissenschaften, Hermanstadt, Transylvania, Gesellschaft der Wissenschaften, K. K. Sternwarte, Prag, Bohemia; Physikalische Gesellschaft, Deutsche Geologische Gesellschaft, K. P. Geologische Landesanstalt und Bergakademie, K. P. Meteorologische Institut, Berlin, Prussia; Naturhistorische Verein, Bonn, Prussia; Physikalisch-Medicinische Societät, Erlangen, Bavaria; Naturwissenschaftliche Gesellschaft "Isis," Dresden, Saxony; Gesellschaft zur Beforderung der gesammten Naturwissenschaften, Marburg, Prussia; Verein der Freunde der Naturgeschichte, Mecklenburg, Germany; Wurttembergische Verein fur Handelsgeographie, Stuttgart; Société de Physique, Geneva, Switzerland; Società Toscana di Scienze Naturali, "Il Nuovo Cimento," Pisa, Italy; Comitato Geologico d'Italia, Rome; Société Linnéene, Bordeaux, France; Société d'Histoire et d'Archéologie, Chalon-sur-Saone, France; Bureau des Longitudes, Société Zoologique, Société Française de Physique, Museum d'Histoire Naturelle, Société de l'Histoire de France, Société Philologique, Paris, France; M. Edward Piette, Saint-Quentin, France; British Association for the Advancement of Science, Zoölogical Society, Prof. Henry Wilde, London, Eng.; Natural History and Philosophical Society, Belfast, Ireland; Royal Irish Academy, Royal Dublin Society, Dublin, Ireland; Historical and Scientific Society of Manitoba, Winnipeg; Boston Public Library, Dr. Samuel A. Green, Boston, Mass.; Free Public Library, New Bedford, Mass.; Essex Institute, Salem, Mass.; Brooklyn Library, Brooklyn, N. Y.; Buffalo Library, Buffalo, N. Y.; American Geographical Society, New York, N. Y.; Geological Society of America, Rochester, N. Y.; Pennsylvania Geological Survey, Harrisburg; Franklin Institute, Editors of the *Pionier Verein*, Mr. Frederick Prime, Philadelphia; Wyoming Historical and Geological Society, Wilkesbarre, Pa.; U. S. Naval Institute, Annapolis, Md.; Johns Hopkins University, Baltimore, Md.; U. S. Department of Agriculture, Bureau of Ethnology, American Historical Association, U. S.

Geological Survey, Washington, D C ; Mr. C E. Jones, Augusta, Ga , University of Nebraska, Lincoln; Instituto Fisico-Geografico y Museo Nacional, San José, Costa Rica, C. A.; Museo de La Plata, Argentine Republic, S. A ; Ministry of Foreign Affairs, Caracas, Venezuela, S. A ; South African Philosophical Society, Cape Town, Agricultural Experiment Stations, Manhattan, Kans, Madison, Wis.

A photograph for the Society's Album was received from Mr. H A. Hill, Boston, Mass.

A circular from the R. Accademia delle Scienze, Turin, Italy, announcing the death of its President, Prof Comm. Michele Lessona.

The deaths of the following members were reported to the Society:

Brugsch Bey, Berlin, Prussia; died September 10, 1894, æt. 67.

Prof. Heinrich Helmholtz, Charlottenberg, Germany; died September —, 1894.

Prof. William Dwight Whitney, New Haven, Conn.; died June 7, 1894, æt. 67.

Dr. William T. Barnard, Boonton, N. J.; died May 9, 1894.

Rear-Admiral Edward Yorke Macauley, Philadelphia; died September 14, 1894, æt. 68.

Dr. Robert Peter, Lexington, Ky.; died April 26, 1894, æt. 89.

On motion, the President was authorized and requested to appoint a suitable person to prepare the usual obituary notice for the late Admiral Macauley.[*]

Dr. Cope presented for the *Transactions* a paper on the "Taxonomy of the Ophidia," which was, on motion, referred to a Committee of three members, to be appointed by the President.[†]

Prof. Cope made an oral communication in reference to a late review in the *Archiv für Anthropologie* (Braunschweig,

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[*] Dr Persifor Frazer was subsequently appointed.

[†] Drs. Ryder, Chapman and Sharp were subsequently appointed.

1893) upon his views of the ancestry of man, pointing out the errors into which the reviewer had fallen.

Pending nominations Nos. 1273, 1274, 1276 to 1301, inclusive, and new nominations 1302 and 1303 were read.

And the Society was adjourned by the President.

Stated Meeting, October 5, 1894.

President, Mr. FRALEY, in the Chair.

Correspondence was submitted as follows:

Letters of envoy were received from the K. Sachsische Gesellschaft der Wissenschaften, Leipzig, Saxony; Royal Observatory, Greenwich, Eng.; Royal Statistical Society, Zoological Society, London, Eng.; Musée de La Plata, Argentine Republic.

Letters of acknowledgment were received from the Geological Survey of India, Calcutta (142); Norwegian Society of Science, Throndligen, Norway (141, 142); R. Academy of Sciences, K. Statistiska Central Byrån, Prof. A. E. Nordenskiöld, Stockholm, Sweden (144); Prof. J. J. S. Steenstrup, Copenhagen, Denmark (144); Royal Society of Sciences, Prague, Bohemia (137–141); Deutsche Geologische Gesellschaft, Berlin, Prussia (142); M. Otto Böhtlingk, Leipzig, Saxony (142); Verein für Erdkunde, Metz, Germany (141); K. Sternwarte, Munich, Bavaria (144); K. Geodätisches Institut, Potsdam, Prussia (142, 144); Württembergische Verein für Handels-Geographie, Stuttgart, Germany (141, 142, 144); Naturforschende Gesellschaft, Schweiz Naturforschende Gesellschaft Bibliothek, Bern, Switzerland (144); Société Vaudoise des Sciences Naturelles, Lausanne, Switzerland (144); Musée Guimet (142, 144); Ct. de Charencey, Marquis de Nadaillac, Dr. Edward Pepper, Paris, France (144); Mr. Samuel Timmins, Arley, Coventry, Eng. (142, 144); Philosophical Society, University Library, Cambridge, Eng. (142, 144); Sir John Evans, Nash Mills, Hemel Hempstead, Eng. (144); Philosophical and Literary Society, Leeds, Eng. (144); Royal Society (142, 144), Geographical Society (144), R. Meteorological Society (142, 144), R. Astronomical Society (142, 144), Linnean Society (142, 144), Geological Society (144), Society of Antiquaries (142), Microscopical Society (142), Royal Institution of Great Britain (142, 144), Meteorological Office (144), Zoological Society (144), Victoria Institute (142, 144), Prof. William Crookes (142), Mr. O. Juhlin Daunfelt (142, 144), Dr. W. H. Flower (142), Sir John Lubbock (144), Col. William Ludlow (142, 144), Sir James Paget (142, 144), Sir Rawson W. Rawson (142, 144), Sir Henry Thompson, London, Eng. (142, 144); Geographical Society, Prof. W. Boyd Dawkins, Manchester, Eng. (142, 144); Natural History Society, Newcastle upon Tyne, Eng. (142, 144); Mr. Alfred R. Wallace, Parkstone, Dorset, Eng. (142); Royal Geological Society of Cornwall, Penzance, Eng. (142, 144); Dr. Isaac Roberts, Crowborough, Sussex, Eng. (144); Sir Henry Bessemer, Surrey, Eng. (144); Yorkshire Geological and Polytechnic Society, Yorkshire, Eng. (142, 144); Royal Society (142), Prof. James Geikie, Edinburgh, Scotland (142, 144); Philosophical Society, Geological Society, Glasgow, Scotland (142).

Accessions to the Library were reported from M. N. A. Cobb, Sydney, Australia; K. N. F. Universitetet, Christiania, Norway; Gesellschaft fur Anthropologie, Ethnologie, etc., Gesellschaft für Erdkunde, Berlin, Prussia; Naturhistorische Gesellschaft, Hanover, Prussia; Physikalische ökonomische Gesellschaft, Königsberg; Institut Grand-ducal, Luxemburg, Germany; Verein für Erdkunde, Metz, Germany, Société Helvétique des Sciences Naturelles, Lausanne, Switzerland; Direzione Generale della Statistica, Ministero di Agricoltura, Institut International de Statistique, Rome, Italy; M. G. Monret, Nicet, France; Prof. Emil Levasseur, Paris, France; Ronsdon Observatory, Lyme Regis, Eng.; R. Cornwall Polytechnic Society, Falmouth, Eng.; Royal Observatory, Greenwich, Eng.; Lords Commissioners of the Admiralty, Linnean Society, London, Eng.; Natural History and Antiquarian Society, Penzance, Eng.; Nova Scotian Institute of Science, Halifax, Université Laval, Quebec, Canada; Natural History Society, Montreal, Canada; Royal Society of Canada, Ottawa; Superintendent of City Trusts, Dr. D. G. Brinton, Mr. Henry Phillips, Jr, Philadelphia; Siemens and Halske Electric Company of America, Chicago, Ill; Observatorio N. Argentino, Cordoba, Argentine Republic; Musée de La Plata, Argentine Republic.

The President reported the appointment of Dr. Persifor Frazer to prepare the obituary notice of the late Admiral Macauley.

Dr. J. Cheston Morris read a paper on "The Ethics of Solomon," as illustrated by the Book of Ecclesiastes, with a translation from the Septuagint.

Pending nominations Nos. 1273, 1274, 1276 to 1303 inclusive were read.

The Committee appointed April 20, 1894, "to consider the state of the Society," etc, made the following report.

PHILADELPHIA, October 5, 1894.

The Committee, appointed under the resolution adopted by the American Philosophical Society, April 20, 1894, "to take into consideration the state of the Society and to report whether any, and if any, what measures it may be expedient to take for increasing the resident membership of the Society, and promoting its usefulness, and whether in effectuating these purposes it may be necessary to amend the existing laws and regulations," beg respectfully to report that they have carefully considered the resolution and recommend that the following changes be made in the laws of the Society as most likely to attain the object of the resolution.

1. They recommend that Chapter I of the laws be abolished, which now stands as follows:

CHAPTER I.

OF THE MEMBERS, AND MANNER OF THEIR ELECTION.

SECTION 1. The election of members shall be by ballot, and shall form part of the stated business of the meetings on the third Fridays of February, May, October and December.

2. A member may, at any meeting, nominate in writing a candidate for membership, and the nomination so made may, in like manner, be con-

curred in by other members The board of officers and council may also nominate candidates for membership and such nominations shall be certified to the Society by minute thereof in writing attested by the clerk of said board

3 No person shall be balloted for unless his nomination with the names of the members proposing him or the minute of the board of officers and council made as aforesaid shall have been publicly read to the Society at the two stated meetings preceding that at which the balloting takes place Nor shall any person be deemed duly chosen unless three fourths of the votes given shall be in his favor

4 Before entering upon an election for members one of the secretaries shall read the names of the several candidates and any member may then for the information of the Society speak to their character and qualifications for membership

5 The names of the candidates and their places of abode shall be designated on the ballots and the names of the officers shall be called in the order of their seniority by the acting secretary the members thereafter depositing their ballots The name of a candidate struck from a ballot or not voted for shall be considered as a vote adverse to that candidate

6 After all the other business of the meeting shall have been disposed of the ballot box shall be opened by the secretaries or in their absence by two tellers, to be appointed by the presiding member who shall then declare to the Society the result of the poll

7 The members are mutually pledged not to mention out of the Society the name of any candidate proposed nor of any withdrawn or unsuccessful candidate and the papers containing the names of the unsuccessful candidates shall be destroyed immediately after the election

8 Every member upon his introduction into the Society shall be presented to the presiding officer and shall subscribe the laws

9 Such members as reside within ten miles of the hall of the Society and such other members as desire to vote at the meetings and elections shall pay an admission fee of ten dollars and annually thereafter on the first Friday of January a contribution of five dollars The payment of fifty dollars at one time, by a member not in arrears shall exempt him from all future annual payments

10 Members elect, residing within ten miles of the hall shall lose the right of membership unless they subscribe the laws and pay their admission fee within one year after their election Any member liable to an annual contribution, who shall neglect or refuse to pay the same for the term of two years, shall be notified by the treasurer in writing on or before the second Friday in January after such default, that his rights as a member are suspended , and in case the said arrears together with the contribution due on the first Friday in January after such notice shall not be paid to the treasurer on or before the said last named day, the membership of such defaulting member shall be forfeited his name stricken from the roll, and reported to the Society by the treasurer

11. On the Society being informed of the death of a member, the fact shall be entered on the records, and a member may be appointed to prepare an obituary notice of the deceased.

12. The obituary notices of members shall be read to the Society, and they shall be bound together whenever they are sufficiently numerous to form a volume.

That in the place of this, Chapter I shall read as follows:

CHAPTER I.

OF THE MEMBERS, AND MANNER OF THEIR ELECTION.

SECTION 1. The election of members shall be by ballot, and shall form part of the stated business of the meetings on the third Fridays of February, May, October and December.

No other business shall be transacted at such meetings until the balloting for the election of members is completed and the result thereof reported to the Society.

SECTION 2. A Committee on Nominations to consist of five members of the Society, not members of the Board of Officers and Council, shall be chosen by ballot on the third Friday of October in each year, to which Committee shall be referred all nominations of candidates for membership, and it shall consider and report from the lists of nominations so referred such persons as said Committee may deem worthy of election to membership. To make such recommendations the vote of the said Committee shall, for each person recommended, be unanimous.

The names of the persons so recommended for membership shall be posted in a convenient place for inspection in the hall of the Society for three weeks preceding the election of members.

SECTION 3. A member may, at any meeting, nominate in writing a candidate for membership, and the nomination so made may, in like manner, be concurred in by other members.

The nomination paper may contain a statement of the grounds upon which the proposed candidate is deemed worthy of membership, or may state merely his name, residence and occupation. The nomination papers shall be filed with the Secretaries and by them be immediately transmitted to the Committee on Nominations, be recorded in a book to be called the "Record of Nominations," and be reported to the Society at its next stated meeting and entered on the minutes.

SECTION 4. At the election of members at least twenty members shall be required for a quorum and any person recommended by the Committee on Nominations having a majority of the votes of the members present shall be deemed to be duly elected.

SECTION 5. The election shall be held by two tellers, to be appointed by the presiding member, who shall receive and count the votes and make report to the Society of the result of the election.

A proper number of tickets containing the names of the candidates favorably reported by the Committee on Nominations shall be printed under the direction of the Librarian, and be ready for distribution among the members at the time designated for holding the election

SECTION 6. Such members as reside within thirty miles of the hall of the Society, and such other members as desire to vote at the meetings and elections, shall pay an admission fee of ten dollars, and annually thereafter, on the first Friday of January, a contribution of five dollars. The payment of one hundred dollars at one time, by a member not in arrears, shall exempt him from all future annual payments

SECTION 7 Members elect, residing within thirty miles of the hall, shall lose the right of membership unless they subscribe the laws and pay their admission fee within one year after their election. Any member liable to an annual contribution, who shall neglect or refuse to pay the same for the term of two years, shall be notified by the Treasurer in writing, on or before the second Friday in January after such default, that his rights as a member are suspended, and, in case the said arrears, together with the contribution due on the first Friday in January after such notice, shall not be paid to the Treasurer on or before the said last-named day, the membership of such defaulting member shall be forfeited, his name stricken from the roll, and reported to the Society by the Treasurer

SECTION 8 On the Society being informed of the death of a member, the fact shall be entered on the records, and a member may be appointed to prepare an obituary notice of the deceased.

SECTION 9. The obituary notices of members shall be read to the Society, and they shall be bound together whenever they are sufficiently numerous to form a volume.

2. That Chapter II, Section 5, which now stands:

5 No one shall be esteemed a qualified voter at the election, who has not subscribed the laws and paid the admission fee, or who is in arrears to the Society, *or has not attended a meeting during a whole year next preceding the election.*

shall be amended to read as follows:

SECTION 5. No one shall be esteemed a qualified voter at the election, who has not subscribed the laws and paid the admission fee, or who is in arrears to the Society.

3. That Chapter VII (Of the Officers and Council), Section 7, which now reads;

7. The president and senior secretary of the Society shall be, ex officio,

the president and clerk at their meetings; and *three* of their number shall be a quorum.

be amended so as to read:

SECTION 7. The President and Senior Secretary of the Society shall be, *ex officio*, the President and Clerk at their meetings, and *seven* of their number shall be a quorum.

4. To change Chapter VIII (Of the Librarian), so that Section 3, which now reads:

3. He shall attend at the library at every meeting of the Society, and daily, excepting Sundays, from *10 A M. to 1 P M*, except when allowed leave of absence by the presiding officer of the Society, and shall then, and at such other times as he may think proper, lend out to any resident member of the Society, who is not indebted to him for fines or forfeitures, any books belonging to the library, except the last volumes and loose numbers of periodical journals, and except recent donations made to the Society, which shall not be lent out; taking from each member borrowing a book an obligation, with a sufficient penalty, to return the same uninjured, within one month thereafter, subject to a fine of fifty cents at every stated meeting that shall occur after the limited period before he returns the book, and a forfeiture of double the value of the book, or of the set of which it is one, if not returned in six months after being borrowed.

so that it shall stand as follows:

SECTION 3. He shall attend at the library at every meeting of the Society, and daily, excepting Sundays *and legal holidays, from 10 A M. to 3 P.M*, except when allowed leave of absence by the presiding officer of the Society, and shall then, and at such other times as he may think proper, lend out to any resident member of the Society, who is not indebted to him for fines or forfeitures, any books belonging to the library, except the last volumes and loose numbers of periodical journals, and except recent donations made to the Society, which shall not be lent out; taking from each member borrowing a book an obligation, with a sufficient penalty, to return the same uninjured, within one month thereafter, subject to a fine of fifty cents at every stated meeting that shall occur after the limited period before he returns the book, and a forfeiture of double the value of the book, or of the set of which it is one, if not returned in six months after being borrowed.

That Section 9, which now stands as follows:

9. He shall receive an annual salary of *seven* hundred dollars, to be

paid monthly from the treasury of the Society and his services shall commence on the first Monday after his election

be amended to read

SECTION 9 He shall receive an annual salary of *nine* hundred dollars to be paid monthly from the treasury of the Society and his services shall commence on the first Monday after his election

That a new section be inserted at the close of the Chapter as follows

SECTION 10 The library shall be closed during the months of July and August but members desiring to use the same shall be permitted to do so under such arrangements as may be made by the Committee on the Library

5 To amend Chapter IX, Section 3, which now stands as follows

3 The qualified voters present at any stated or special meeting shall be a quorum and be competent to elect members dispose of property appropriate money, and award premiums but no property shall be alienated or encumbered, except by the vote of three fourths of the qualified voters present and given at two successive stated meetings For the transaction of the ordinary business, the reception and reference of communications on literary, scientific, or other subjects all other members present shall be deemed competent to act, and in the absence of qualified voters shall form a quorum

so as to read

SECTION 3 *Twenty* qualified voters present at any stated or special meeting shall be a quorum, and be competent to elect members dispose of property, appropriate money, and award premiums, but no property shall be alienated or encumbered, except by the vote of three fourths of the qualified voters present, and given at two successive stated meetings For the transaction of the ordinary business, the reception and reference of communications on literary, scientific, or other subjects, all other members present shall be deemed competent to act and, in the absence of qualified voters, shall form a quorum

All of which is respectfully submitted,

FREDERICK PRIME, *Chairman.*
W. P TATHAM,
F FRALEY,
GEORGE H HORN.

Mr. Prime moved that the report of the Committee be made the stated business of the meeting to be held on Friday, October 19, 1894, and that the Secretaries be directed to print and distribute the report to the resident members before the next meeting.

The motion being seconded was carried.

And the Society was adjourned by the President.

Stated Meeting, October 19, 1894.

President, Mr. FRALEY, in the Chair.

Correspondence was reported as follows:

Letters of envoy were received from the Geological Survey of India, Calcutta; Société R. des Sciences, Upsal, Sweden; K. Sachsiche Gesellschaft der Wissenschaften, Leipzig; K. Geodatisches Institut, Central Bureau der Internationalen Erdmessung, Potsdam, Prussia; Verein für Vaterlandische Naturkunde in Wurtemberg, Stuttgart; Academy of Science, St. Louis, Mo.

A letter was received from the R. Accademia delle Scienze, Torino, Italia, announcing the death of Ariodante Fa Oretti, one of its members.

Letters of acknowledgment were received from the Geological Survey of India, Calcutta (144); K. K. Central-Anstalt für Meteorologie, etc., Vienna, Austria (142, 144); Redaction der *Naturwissenschaftlichen Wochenschrift* (180, 184, 187); K. Akademie der Wissenschaften, Berlin, Prussia (144); Naturwissenschaftliche Verein, Bremen, Germany (142, 144); K. Sachs. Met. Institut, Chemnitz, Saxony (140, 142, 144); Geographische Gesellschaft, Hanover, Prussia (142); K. Sächs. Sternwarte (142, 144), Dr. Otto Böhtlingk, Leipsig, Saxony (144); Verein für Vaterländische Naturkunde in Würtemberg, Stuttgart (140, 141, and *Trans.*, xvii, 3, xviii, 1); Société R. des Sciences, Upsal, Sweden (137–141, and *Trans.*, xvii, 1, 2, 3, xviii, 1); Mr. Samuel Timmins, Arley, Coventry, England

(144); Royal Observatory, Edinburgh, Scotland (142, 144); Mr. Horatio Hale, Clinton, Canada (144); Bowdoin College Library, Brunswick, Me. (144); Dr. Justin Winsor, Cambridge, Mass. (142); Marine Biological Laboratory, Woods Holl, Mass (142); State Library, Albany, N. Y. (142, 144); Prof. J. E. Oliver, Ithaca, N. Y. (144); Academy of Science, Rochester, N. Y. (144); Mr. Arthur Biddle (144), Dr. John H Brinton (142), Mrs. Helen Abbott Michael (144), Messrs. J G Rosengarten (144), Julius F. Sachse (144), L. A. Scott (141, 144), Philadelphia; Prof. John F. Carll, Pleasantville, Pa. (144); Prof. J. T. Rothrock, West Chester, Pa. (144); U. S. Naval Institute, Annapolis, Md. (144); Bureau of Ethnology, Hon. William Strong, Washington, D. C. (144); Academy of Science, Austin, Texas (142, 144); University of Iowa, Iowa City (144); Agricultural Experiment Station, Manhattan, Kansas (141, 142, 144); Washburn College, Kansas Academy of Science, Topeka (144); Lieut. A. B. Wyckoff, Seattle, Wash (144); Historical Society of Southern California, Los Angeles (144); Prof. Daniel Kirkwood, Riverside, Cal. (144); Bishop Crescencio Carrillo, Merida, Mexico (144); Observatoire Météorologique Central de Mexico, Observatorio Astronomico de Tacubaya (144); Commissao Geographica e Geologica de San Paulo, Brazil (136, 139, 140); Institute of Jamaica, Kingston (142).

Letters of acknowledgment (145) from the New Hampshire Historical Society, Concord; Vermont Experiment Station, Burlington; Rhode Island Agricultural Experiment Station, Kingston; Providence Franklin Society, Providence, R. I.; State Library, Albany, N. Y.; Agricultural Experiment Station, Geneva, N. Y.; Geological Society of America, Rochester, N. Y.; Oneida Historical Society, Utica, N. Y.; Prof. Robert W. Rogers, Madison, N. J.; Prof. Charles W. Shields, Princeton, N. J.; Dr. Charles B. Dudley, Altoona, Pa.; Prof. Lyman B. Hall, Haverford, Pa.; Mr. P. F. Rothermel, Linfield, Pa.; Dr. Persifor Frazer, Prof. H. D. Gregory, Philadelphia; Mr. Thomas Meehan, Germantown, Philadelphia; Enoch Pratt Free Library, Maryland Institute, Peabody Institute, Baltimore, Md.; Mr. T. L. Patterson, Cumberland, Md., U. S. Geological Survey, Library Surgeon General's Office, U. S. Weather Bureau, Messrs. John S. Billings, W. J. Hoffman, Garrick Mallery, Charles A. Schott, William B. Taylor, Washington, D. C.; University of Virginia, Leander McCormick Observatory, Prof. J. W. Mallet, University of Virginia, Va; Mr. Jedediah Hotchkiss, Staunton, Va.; Agricultural Experiment Station, Raleigh, N. C.; Georgia Historical Society, Savannah; Newberry Library, Chicago, Ill.; Rantoul Literary Society, Rantoul, Ill.; State Historical Society, Iowa City; Prof. E W. Claypole, Akron, O.; Cincinnati Observatory, O.; Journal Comparative Neurology, Granville, O.; Oberlin College Library, O.; Purdue Experiment Station, LaFayette, Ind.; State Historical Society of Wisconsin, Academy of Sciences, etc., Madison; Kansas Academy of Science, Topeka; University of California, Prof. Joseph Le Conte, Berkeley, Cal.; Historical Society of Southern California, Los Angeles; Lick Observatory, Mt. Hamilton, Cal.; Prof. Daniel Kirkwood, Riverside, Cal.; Nebraska State Historical Society, Lincoln; Colorado Scientific Society, Denver; University of Wyoming, Laramie; South Dakota Agricultural College, Brookings; Academy of Science, Tacoma, Wash.; Bishop Crescencio Carrillo, Merida, Mexico; Observatorio Astronomico Nacional, Don Mariano Barana, Mexico, Mex.

Accessions to the Library were reported from the New Hampshire Historical Society, Concord; Dr. Samuel H. Scudder, Mr. Andrew McFarland Davis, Cambridge, Mass.; Connecticut Historical Society, Hartford; Yale University, New Haven, Conn.; University of the State of New York, Albany; Academy of Sciences, Scientific Alliance, Profs. J. A. Allen, W. LeConte Stevens, Mr. James Douglas, New York, N. Y.; Academy of Science, Rochester, N. Y.; Pennsylvania State College, Harrisburg; College of Pharmacy, Oriental Club of Philadelphia, Messrs. MacCalla & Co., Mrs. Wistar, Philadelphia; Peabody Institute, Baltimore, Md.; U. S. Department of Agriculture, Treasury and War Departments, Washington, D. C.; Law School of Mercer University, Macon, Ga.; University of California, Berkeley; University of Wisconsin, Madison; Historical Society, Lincoln, Neb.; Geological Survey, Minneapolis, Minn.; Observatorio Astronomico y Meteorologico, San Salvador, Central America; Sociedad Cientifica Argentina, Dr. Estanislao S Zeballos, Buenos Aires, South America; Observatorio Nacional Argentina, Cordoba, South America.

The death of Dr. Oliver Wendell Holmes (Boston) was announced, October 7, 1894 (æt. 86).

The proposed amendments to the Laws of the Society were taken up.

The Librarian stated that public notice had been given in the newspapers that the Society would consider same at this meeting, and furthermore, that printed copies of the said amendments had been sent to the members before the date of the meeting, and that the quorum required by the Laws was present.

Mr. Prime moved to consider Sections 1 to 5, Chapter I, inclusive, together. The motion was carried.

Mr. McKean moved to amend paragraph 2 of Section 1, to strike out "no other business shall be transacted at such meeting until the balloting for the election of members is completed and the result thereof reported to the Society," and to substitute instead at end of 1st paragraph, "and it shall have priority over all other business until the balloting be completed."

The President stated that, agreeably to the custom of the Society, if any amendments were agreed to, that the Law so amended must lie over for two weeks.

Mr. McKean's motion was put and carried.

Mr. McKean moved to strike out the words "not members of the Board of Officers and Council" from Section 2.

Mr. McKean moved to amend the same section by striking out the words "be *unanimous*" and inserting instead "there shall be an affirmative vote of at least *three* members of the Committee."

The members discussed the question of public posting of names in the Society's Hall.

Mr. Prime submitted the following substitute for Section 2:

SECTION 2. A Committee on Nominations to consist of six members shall be chosen by ballot at the Stated Meeting of the Society, to be held on the third Friday of November, 1894, of whom two shall serve for one year, two for two years, and two for three years, and annually thereafter on the third Friday in November, two members of said Committee shall be chosen by ballot to serve for three years, but the retiring members shall not be eligible for re election, until a year from the expiration of their office. Any member not attending a meeting of the Committee for six months shall be deemed to have vacated his office Vacancies in this Committee occurring from any cause whatever, shall be filled by appointments made by the President of the Society, or if there be no President in office, then by the senior Vice-President. To this Committee shall be referred all nominations of candidates for membership, and it shall consider and report from the lists of nominations so referred, such persons as said Committee may deem worthy of election to membership.

To make such recommendations, the vote of at least four members of said Committee shall be required. The names of the persons so recommended for membership shall be posted in a convenient place for inspection in the Hall of the Society for three weeks preceding the election of members.

Members spoke to the amendment.

Mr. Prime called for a vote on his amendment.

Dr. Cope offered the following amendment: "That a vote of three members of the said Committee shall be a majority."

The vote was taken on Mr. Prime's motion, and it was carried by 18 ayes, 4 nays.

Then on Mr. Prime's amendment, which was lost, ayes 9, nays 11.

The amendment of Dr. Cope was put and carried, ayes 12, nays 6.

Dr. Greene moved that, it is the sense of the Society that it is inexpedient to make any change in the method of electing its members, then withdrew the same and offered a resolution to postpone the further consideration of the amendments in order to introduce the above motion.

The motion was lost, 10 ayes, 11 nays.

Mr. McKean moved to strike out the words "not members of the Board of Officers and Council," which was debated and carried by a vote of 18 ayes and 8 nays.

Dr. Morris moved to strike out second paragraph of Section 2, and substitute as follows:

All nominations shall be open to inspection by members of the Society when the Hall is open, under charge of the Secretaries.

The Committee on Nominations shall hold stated meetings on the second Fridays of January, April, September and November, when those interested may state their reasons for or against any candidate but the members of the Society are mutually pledged not to mention out of the Society the name of any candidate proposed, nor of any withdrawn or unsuccessful candidate, and the papers containing the names of unsuccessful candidates shall be destroyed immediately after the election following.

Dr. Cope moved that the words "the names of the persons so recommended for membership shall be placed in a convenient place for inspection in the Hall of the Society for three weeks preceding the election," be struck out.

Mr. Prime explained the reason of the paragraph.

Dr. Brinton moved to adjourn. The motion was lost ayes 7, nays 14.

The question being taken on Dr. Cope's motion, it was carried.

Dr. Greene moved to indefinitely postpone action on the amendments.

Mr. Prime moved to make the amendments prepared by the Committee the stated business of the next regular meeting.

It was moved to adjourn. Carried, ayes 17.

And so the Society was adjourned.

Some Coal Measure Sections Near Peytona, West Virginia.

By Benj Smith Lyman.

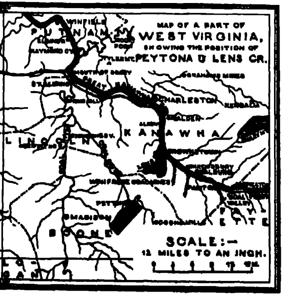
(Read before the American Philosophical Society, November 2, 1894.)

Some results of a couple of rough surveys made in 1872, near Peytona, Boone Co., W. Va., though without any addition from later observations, may be a useful contribution towards the elucidation of the geology of that region. The graphic comparison of columnar sections there with Prof. J. J. Stevenson's careful general section in the northern edge of that State, as published, without any diagram, in our *Transactions*, Vol. xv, p. 15, 1872, shows a remarkable general agreement, considering the great distance. The present sections also help very much in the identification of the different coal beds of the region, hitherto insufficiently studied, as remarked by Prof. I. C. White, in his valuable "Stratigraphy of the Bituminous Coal Field of Western Pennsylvania, Ohio and West Virginia," *U. S. Geol. Surv. Bulletin*, No. 65, p. 148, 1891.

It will be well to indicate first, with some precision, the situation of the tracts surveyed, and then briefly their main topographical features, before giving the geological details of the general structure and of the special observed facts, and pointing out the remarkable agreement of the resulting columnar sections with the distant northern section, and discussing the identification of beds that is consequently to be inferred.

SITUATION.

The accompanying small map shows in a general way the situation of the two tracts and their relative position.



One of the surveys covered the tract owned by the Peytona Cannel Coal Company, at Peytona, on Coal River, thirty-five miles above Coalsmouth (or St. Alban's), on the Kanawha, and about twenty two miles by road south of Charleston, the State capital, and twelve miles southerly from Brownstown It is a tract of 6187 acres, in the shape nearly of an oblong square about five miles long by a mile and three quarters wide, with the long sides running about northeast.

The other survey covered the two Parker tracts on Lens Creek (marked as Callacham's Creek, on some maps), both together about 6500 acres, and somewhat in the shape of a leg of mutton, or of a rather one sided oak leaf with the stem of the leaf or smaller end about a mile southwest of the mouth of the creek, near Brownstown, on the Kanawha, ten miles above (southwest of) Charleston, and with the eastern side running in a sinuous course southerly about three miles and a half, and the western side mainly following the course of the creek. The southwestern corner is about four miles northeast of Peytona.

LAY OF THE LAND

The land of both surveys has the same general topographical character that is found under like geological conditions throughout so large a region in West Virginia and western Pennsylvania, namely, very steep, often cliffy, hillsides and narrow valleys, with the hills rising 800 to 900 feet, or even more to summits that are mostly narrow, here and there even sharp, but in some places broad and flat, and with narrow strips of nearly flat land, up to a couple of hundred yards in width, along the lower and comparatively level parts of the streams. The lowest points in each survey are some 600 feet above sea level.

The Peytona tract is drained by Coal River, flowing westward across its northern end, and in the central part by Indian Creek, flowing northerly, the western edge by the eastern branches of Droddy's Creek, up as far as its Lick Fork at the southwest corner ; and the southern corner by the head waters of the Sandy Lick Fork of Laurel Creek.

On the Parker tract, the lower part of Lens Creek, from its forks northeastward three-quarters of a mile to its mouth forms the stem of the oak leaf shape, and the midrib of the leaf is the left fork of Lens Creek, with long side ribs and veinlets on the western side, and shorter ones on the east. A narrow strip besides is added along the west, containing the most eastern branches of the right fork of Lens Creek, which forms the western boundary. Both forks fall only fifty or sixty feet to the mile for four miles above their union ; but above that much more rapidly.

GEOLOGY.

STRUCTURE.—The geological structure that occasions the peculiar topographical character, with flat, table-like hilltops here and there, with flat valleys and with many cliffs on the almost uniformly abrupt hillsides is, of course, the very level bedding of a great thickness of rocks at a sufficient height above sea-level.

In the northern part of the Peytona tract, the rock beds seem to lie pretty regular, with the very gentle dip of 1 to 102, or 51¾ feet to the mile, southeasterly, and the strike of N. 14½° E The same dip and strike perhaps continue throughout the southern part of the tract, but the lack of surveys there leaves this point uncertain. There are slight local variations from the general dip causing "swamps" in the mines, say one hundred yards across, and sinking, say, one or two feet, such swamps, however, as are common to all our western, flat lying coal measures.

On the Parker tracts the dip is so slight that without much careful levelling it would be impossible to tell exactly what it is, or whether it is the same throughout the tracts. It seemed at the time of the survey and of drawing the map, to be in general uniform throughout them, and to be towards the north-northeast (N. 20° E) about one foot in 78, or 68 feet to the mile. But there are local variations of the dip here, too, extending a few hundred yards, or at least "swamps" in the coal beds, depending on the varying thickness of the rock-layers

It now seems, however, not improbable that the strike lines, drawn straight and parallel on the two large maps throughout the tracts of each survey, should have been gently curved as indicated by the lines of shading of the two surveys on the accompanying little map of their general situation, making the strike curves of one survey conform, by gradual transition, to those of the other, and to correspond with the northwesterly dip that is said to prevail at Coalburg, on the opposite, southeasterly side of the broad, shallow basin. The strike curves on Lens Creek would then be gently convex towards the northeast, and those of Peytona would be slightly so towards the east. Nevertheless, this little change would not affect the principal results of the surveys, nor the identification of the beds

Rock-beds.—The following is a general section downwards of the rocks exposed on the Peytona tract, so far as known :

		FT	IN
Partly hidden, but chiefly sand rock and shales...about		155	0
Gray clay	"	1	0
Coal, *Pittsburgh Bed*, with some slate............	"	4	0
Hard fireclay and sand rock and shales	"	28	0
Coal, bituminous, soft..........................	"	0	4
Fireclay and hidden, but no doubt mostly sand rock and shales	"	85	0
Coal, bituminous	"	0	4
Fireclay and hidden, but no doubt mostly sand rock and shales	"	90	0
Bony coal......................................	"	0	8
Hidden, but no doubt chiefly sand rock and shales	"	55	0
Coal, bituminous, with two feet of fireclay in the middle.	"	5	0
Hard, gray sand rock and hidden, but doubtless mostly sand rock and shales	"	130	0
Coal, bituminous	"	0	6

		FT	IN.
Hidden, but no doubt chiefly sand rock and shales	about	13	0
Black slate	"	0	4
COAL, bituminous	"	0	2
Shale, or slate	"	0	4
Sand and bituminous coal mixed	"	0	9
Iron ore (carbonate)	"	0	0¼
Slate and sand rock mixed	"	0	8
Black slate	"	0	5
Cannel slate ("bastard cannel")	"	0	1
Slate	"	0	1
Fireclay	"	0	2
Cannel slate ("bastard cannel")	"	0	1½
Fireclay	"	0	2
COAL, *Upper Cannel*, all "smooth cannel"	"	2	6
Cannel slate ("bastard cannel"), with fossil shells	"	0	2¼
Sand rock and sandy shales	"	15	0
Slate	"	0	6
Iron ore	"	0	0½
Slate and iron ore mixed	"	1	0
Iron ore	"	0	0
Slate	"	0	10
Shale	"	0	4
Cannel slate	"	0	3
Fireclay	"	0	2
COAL, *Main Cannel*, partly bituminous	"	2	10
"Slate"	"	1	0
"Bastard cannel"	"	0	5
"Slate"	"	1	0
"COAL," bituminous	"	0	7
Hidden, but no doubt mostly sand rock and shales	"	69	0
COAL, *Sheet Bed*	"	3	6
Hidden, but doubtless chiefly sand rock and shales	"	17	0
Sand rock	"	4	0
Sandy shales	"	2	0
COAL, *Blacksmith Bed*	"	2	0
Fireclay and brownish gray sand rock	"	6	0
Sand rock and shales	"	37	0
Brown shales with small iron-ore balls	"	20	0
Black slate	"	0	8
Shales and sand rock	"	27	6
Sand rock, very cross bedded, brownish gray	"	9	0
COAL, bituminous	"	0	3
Sand rock, brownish gray, Penna. Formation No. XII			
		800	0

The following is a general section downwards of the rocks exposed on the Parker or Lens creek tracts so far as known

		FT	IN
Gray sand rock	about	3	0
Hidden		30	0
COAL *Pittsburgh Bed* 4 9 to 5 6 say		5	0
Hidden		44	0
Brownish gray sand rock		4	0
Hidden		14	0
Slates		6	0
COAL *Slate Vein* in two or three thin layers separated by much clay the upper one cannel average say		3	0
Hidden		190	0
Brownish gray sand rock		5	0
Hidden		105	0
COAL *Wood's Upper Bed* with commonly about half an inch of clay at about six inches below the top 2 6(?) to 4 0 average say		3	0
Hidden		7	0
Brownish gray sandy shales and sand rock		37	0
COAL *Factory Bed* 0 9 to 3 8 with about two thickish layers of clay average		3	0
Brownish gray sandy shales		21	0
Hidden		20	0
Brownish gray sand rock		10	0
Hidden		4	0
Brownish gray sand rock		12	0
COAL *Wood's Lower Bed* commonly with a half inch seam of clay about five inches above the bottom 3 3½ to 4 0½ average say		3	8
Slate floor of coal and hidden		23	0
COAL a very thin seam say		0	4
Black slate		2	0
Hidden		24	0
Brownish gray sand rock		13	0
Hidden		6	0
Brownish gray sand rock		5	0
Brownish gray sandy shales sometimes with small iron ore balls		15	0
COAL *Jerrold's Bed* with sometimes a half inch layer of clay at about nine inches below the top sometimes one near the bottom also 2 8 or even less to 3 6 average say		3	0
Brownish gray sandy shales		14	0
COAL *Vicker's Bed* perhaps		2	0
		640	0

COAL OPENINGS

PITTSBURGH COAL.—The Pittsburgh coal bed has been opened at only one place on the Peytona tract or in the neighborhood; and that was near the top of the mountain above the mines and east of them The section measured there was as follows, from above downward.

	FT	IN	FT	IN
Loose sandstone blocks, somewhat limy?				
Sand rock, thick				
Hard gray clay	1	0		
Good COAL	0	11⅛		
Slate	0	2		
COAL and slate mixed	1	4		
Slate	0	2		
Good COAL..	0	8⅛	4	0
Slate.....	0	8⅛		
COAL.	0	0⅛		
Slate	0	1		
Good COAL	0	8		
Fireclay.................				
	5	0		

The coal bed contains, then:

	FT	IN
Good coal	1	11
Slaty coal..........................	1	4
Slate	0	9
	4	0

That is, however, so much inferior both in thickness and in quality to what the same bed is even as near as Lens Creek, and still more to what it is in the northern part of the State, that it seems not unreasonable to hope that its average throughout the tract may prove better than at this opening

On Lens creek the bed forms but small patches on the hilltops, and has (1872) been opened in only one place, namely, on the hill opposite Mrs. Nuby's house and King's Hollow, about the middle of the eastern edge of the map; with the following section, from above downward.

	FT.	IN.
Loam, with crop-coal............................		
COAL........	1	9
Clay................................	0	6
COAL, with half-inch layers of clay at about four and six inches from the bottom, and perhaps at about a foot and a foot and a half from the bottom........	3	4
	5	7

The opening is not a very perfect one, and perhaps does not show the full thickness. The quality is only imperfectly shown, as the coal dug had no solid cover and is all mere crop coal, yet seems to be good.

The bed has been worked at Curry's mine, in Church Hollow, about one hundred yards outside the Parker tracts, and just outside the northeastern corner of the Lens Creek map, with the following section from above downward:

	FT	IN.
Sand rock		
COAL	1	5
Gray slate	0	2
COAL	3	2
Fireclay		
	4	9

The SIX-INCH BITUMINOUS COAL bed about twenty-three feet below the Pittsburgh bed at Peytona, was opened in June, 1872, on the lumber slide above the No. 1 Entry of the old Peytona mines.

The FOUR INCH SOFT, BITUMINOUS COAL bed about one hundred and ten feet below the Pittsburgh bed, at Peytona, was opened in June, 1872, on the lumber slide above the No. 1 Entry of the old Peytona mines, with a fine looking bed of fireclay partly exposed below

SLATE VEIN.—The slate vein on Lens Creek was opened by an old drift, near Curry's coal mine in Church Hollow, just outside the northeast corner of the map; and measured as follows, from above downward:

	FT.	IN	FT	IN
Slates, exposed some	6	0		
Coal, cannel	1	2	3	5
Black slate	1	0		
COAL, soft, bituminous, more than half under water, about	1	3		
	9	5		

The same bed was also opened in June, 1872, on the hillside up the hollow opposite Mrs. Nuby's house and King's Hollow on the Left Fork of Lens Creek, below the opening of the Pittsburgh bed there; and measures as follows, from above downward:

	FT	IN.
Clay, gray, perhaps not in place		
COAL, cannel, slaty	0	8
Brown slate or clay, with a little coal	0	5½
Coal, bituminous	1	0
Gray clay	0	5½
COAL, bituminous	0	6
	3	3

The THREE-INCH BONY COAL about two hundred feet above the upper cannel coal bed was opened above Entry No. 4, at Peytona, in 1872; but only showed two or three inches of bony crop-coal, or crop-cannel, or perhaps merely crop-slate.

The THREE FOOT BITUMINOUS COAL bed about one hundred and forty feet above the upper cannel on the Peytona tract, has been partially opened above Entry No. 4, with the following section from above downward:

	FT	IN
Loam .... about	2	0
Crop COAL, splint like	1	0
Fireclay	1	5
COAL, bituminous, firm and good	2	6
	6	11

It may prove workable in some places, but cannot probably be counted on as such throughout the tract. It is most likely the same as a bed of unworkable thickness that has been opened on the waters of Indian creek, either the "Third Cannel," in Abshire's Hollow and on Meadow's Fork (a bed yielding there about seven inches of cannel at the bottom with bituminous coal above it), or a thin bed of bituminous coal said still more to resemble it, formerly opened some twenty feet higher up, on Meadow's Fork.

The SIX-INCH BITUMINOUS COAL some twenty feet above the upper cannel was opened on the top of the point on the south side of Droddy's Creek, near the western edge of the map; and is said to have been six inches thick, pretty firm, but not splint-like, without solid roof, but about two feet of rather hard clay above it. The same bed shows about three inches of outcrop, without solid roof or floor, about thirty two feet above the bottom of Entry No. 4, of the Peytona mines and on the north side of the hollow.

UPPER CANNEL.—The thicknesses of the beds in the general section within three or four feet above the Upper Cannel bed are the means of measurements at two places, except that the thickness given for the principal cannel bench is the average of four measurements near the mines. That bench, however, is still more variable hereabouts. It has been worked at the Peytona mines by a short drift, on which it measures twenty-seven inches and about thirty-one inches, and has also been opened by a slope from the Main Cannel bed and measures there twenty-one inches.

On Abshire's Branch of Indian Creek, half a mile southeast of the Peytona mines, the same bed is opened in several places, and at one of them measures as follows, from above downward:

	FT	IN
Slate..		
COAL..	0	6
Brownish-gray sand rock..... ....about	3	6
Brown shales.................................. "	1	6
Cannel COAL................................. "	1	11
Shales, exposed.......................... ... "	0	3
	7	8

At another opening, about two hundred yards further up the branch and on its north side, the following section with the same bed is exposed from above downward:

	FT	IN
COAL, bituminous, "hard," merely the tail of the outcrop......	0	9
Slate	2	0
Cannel COAL................................. .	1	3
	4	0

At an opening about thirty yards distant on the south side of the branch the Upper Cannel is about ten inches thick, but it is only the tail of the outcrop not well roofed over.

An opening was made on the Upper Cannel in June, 1872, back of John McCarty's house on Droddy's creek, in the western edge of the tract, and gave the following section from above downward.

		FT	IN
Sand rock, massive....	about	2	0
Shales.........	"	3	0
COAL, soft, rotten, bituminous.............. .	"	0	6
Clay	"	0	6
Black slate	"	0	0¼
CANNEL, the upper inch perhaps a little bony .	"	3	2¾
		9	3

The Upper Cannel was also opened in 1872 on the hillside over the blacksmith's shop on Droddy's Creek, half a mile northwesterly from the mines, and measures but 10¼ inches, of which only the upper nine-eighths of an inch are cannel or cannel slate, the rest all bituminous; but there was only clay and loam above, without any solid roof.

The quality of the cannel coal of this bed at Peytona is very good, though not quite equal to the remarkably fine coal of the Main Cannel bed.

On Lens Creek the Upper Cannel coal bed is of different character, but is beyond question the bed called there Wood's Upper Coal. It seemed in 1872 to have been worked only at Wood's upper mine on King's branch, where it was opened by a drift about twenty feet long in the winter of 1869 and 1870, with the following section from above downward:

		FT.	IN.
COAL, bituminous, softer........................	about	0	9
Clay	"	0	0¼
COAL, bituminous, hard, "splint"............	"	2	8
		3	5¼

It was not then fully accessible on account of water dammed back by fallen earth at the mouth.

The same bed was imperfectly opened at the head of Big Hollow, in 1872, with the following section from above downward

		FT	IN.	FT.	IN
Loose clay and shaly wash . .....about		2	0		
COAL, much weathered, rather hard	"	0	6	3	9
Clay	"	0	0½		
COAL, hard and firm, but weathered	"	3	2½		
Black slate, exposed	"	0	1		
		5	10		

The same bed was opened in 1872 on the very steep hillside on the south side of Schoolhouse Hollow, near the middle of the east edge of the map, with the following section from above downward

		FT	IN.	FT.	IN
Slate roof exposed ... . about		2	0		
COAL, softer	"	0	5½	3	3¾
Clay	"	0	0¼		
COAL, hard, "splint"..	"	2	10		
		5	3¾		

Floor, said to be slate, two inches under water.

Another opening made on the same bed in 1872, on Bee Branch, near the southern edge of the map, gave the following section from above downward

		FT	IN.	FT	IN
Slate ....about		1	0		
COAL, rather soft..	"	0	4½	3	3
Clay.............................	"	0	1		
COAL, bituminous, hard, "splint".	"	2	9½		
Brownish gray, fine, hard sand rock	"	1	0		
		5	3		

A rather imperfect opening made on the same bed in 1872 nearly opposite Nuby's house on the left fork of Lens Creek had the following section from above downward:

No roof but loose material, mostly brownish gray sandstone blocks.

	FT.	IN
COAL, bituminous........................	0	3½
Gray clay............................ ......about	0	1½
COAL, bituminous.............	2	1
Bony COAL..	0	6
COAL, bituminous................................ .	0	6
	3	6

Another opening on the same bed made imperfectly in 1872 at Perfater's Spring, on a small branch of the left fork of Lens Creek, nearly south of Lavender's house, gave the following section from above downward.

No roof but wash.

	FT	IN
COAL, slaty.................... ....about	0	1
COAL, with half an inch of clay about the middle, "	0	11
Hard fire clay		
	1	0

The spring is only about three feet distant. Its water is called good, but said to taste a little sulphury.

It is probably the same bed that was very poorly opened in 1872 rather high up the hillside in Poels' Hollow, with the following section from above downward:

Wash loam.	FT.	IN	FT	IN.
COAL.............	0	8½	2	2
Clay	0	1¼		
COAL..	1	6½		
Clay..	0	0¾		
COAL..	0	2		
Clay, exposed. .. . . about	0	6		
	2	8		

The coal is only bituminous, and nothing but dirty crop-coal, and so not of very good appearance.

The bed was also opened in 1872 near Asa Ferrel's house, and near the southwest corner of the map, just above the so-called Ferrel's coal opening on the Factory Coal Bed, or the Peytona Main Cannel, and had the following section from above downward:

Roof, not solid.	FT	IN.
Coal, bituminous, "splint"	0	6
Fireclay	0	6
Coal, bituminous, "splint"........................	1	6
	2	6

The coal of Wood's Upper Bed is bituminous, of very fine quality, especially the main bench, below the seam of clay. The main bench is a remarkably firm splint coal, extremely well suited for steam purposes or domestic fires, or probably even for burning raw in iron furnaces. It is easily mined in large blocks that bear rough handling extremely well. A fair specimen of it was assayed in 1872 by the very able chemist, Dr. George A. Koenig, and yielded:

Coke	68.35
Gas..	23.25
Ashes (gray)...	6.45
Hygroscopic water.........	1.95
	100.00

The coal seems to be very free from sulphur The thin upper bench is less firm than the main one This bed is undoubtedly the one described in the following extracts from a report on these tracts by the celebrated Professor James Hall (1854) as quoted in the pamphlet of the St George Mining and Manufacturing Company New York 1865 page 7

This bed was first opened on the point of a low hill in the rear of Mr Vickar s house as shown on the map At this point it is three feet ten inches thick Although in a most exposed situation and covered only by a slight thickness of clay the coal was quarried out in blocks of large size and breaking into smaller masses only by the application of considerable force

The aspect of the coal is that of a laminated cannel coal with thin seams of bituminous coal intervening but altogether forming a small part of the whole On burning this coal side by side with the cannel coal from the bed previously mentioned there was a remarkable similarity in the color and character of the flame the amount of smoke and the ash The coal burns with much white or yellowish white flame with little crepitation and with a small quantity of smoke It maintains its form showing no disposition to melt or run and in the process of burning throws out numerous jets of white flame in addition to the steady burning flame When partially burned it presents a fine porous coke finally burning away to a white or light colored ash without in the cases tried any appreciable quantity of slag or other impurity The flame and quantity of smoke from a piece of cannel coal burned at the same time and by the side of this coal were not perceptibly different

From this little experiment twice repeated at the locality I infer that for all purposes for producing steam or for a steady dry burning blazing coal the coal from this bed will answer all the purposes of the real cannel coal and for these objects will be equally valuable The only advantage possessed by the cannel coal for domestic use is that of its freedom from soiling in the process of handling I am inclined therefore to regard this bed of coal as of very great value particularly upon the western rivers and for the steam boilers of all manufactories where the prevailing coals are of the soft bituminous character

I may mention that such is the indestructibility of this coal from ordinary atmospheric agencies, that large fragments may be picked up in the beds of the streams half a mile from the coal in place and the specimens burned were of such samples which had lain exposed to the weather probably for centuries. I need scarcely mention that from this remarkable indestructibility of the coal from the agency of the weather and from its breaking out in large blocks even on the exposed outcrops it is remarkably adapted to bear transportation with little loss from breaking or waste

"This combination of qualities, which I hesitate not to say is possessed by no other coal in this region, except the cannel coal, renders it extremely valuable to any parties who propose to mine and send coal to market

The bed seems to thin out, not only southwestward towards Peytona, but northwestward towards the Kanawha , for near the river it measures but 2 feet 10 inches in one place, and would seem to be much less than that in Church Hollow and thereabouts. At the few points, however, where fully opened on the Parker tracts, it seems to be of good workable thickness; and the bed seems to have its greatest size just here, and to be in general little noticeable everywhere else in the neighborhood.

The "bastard cannel" at the bottom of the upper cannel coal bed, at Peytona, contains numerous fossil shells.

MAIN CANNEL.—The Main Cannel coal bed had, in 1872, been worked for twenty years or more at the Peytona mines and near them, as well as at the adjacent mines of the Western Mining and Manufacturing Company. Seven measurements of the coal at different parts of the Peytona mines give the following section of the bed from above downward ,

	FT.	IN	FT.	IN.
Smooth cannel, 1,, 8 to 2,, 1, average, about	1	10	2	6
Curly (or birds' eye) cannel, 0,, 0 to 1,, 6	0	8		
Bituminous coal, 0,, 0 to 0,, 8	0	4	0	4
	2	10	2	10

After those measurements were made, another part of the mine yielded cannel, both kinds together, 3 feet 5 inches thick, the lower 17½ inches being curly and the rest all good cannel.

An opening on the river front of the hillside over Halsted's farm about three-quarters of a mile northeast of the mines shows the following section from above downward :

	FT.	IN	FT.	IN.
Brownish-gray slate about	8	0		
Wild cannel or very bony cannel, or cannel slate	0	1		
Clay	0	1		
CANNEL, the lower inch a little mixed with bituminous coal	0	5	1	11
COAL, bituminous, very hard	0	9		
Clay	0	1		
COAL, bituminous, very hard, somewhat resembling "curly cannel"	0	7½		
	10	1½		

In Abshire's Hollow, about half a mile southeast of the mines, the bed is opened, with the following section from above downward :

	FT.	IN.
Smooth CANNEL	0	3
COAL, hard bituminous	0	11
Smooth CANNEL	0	10
	2	0

An opening near Droddy's Creek, about three quarters of a mile northwesterly from the Peytona mines, gives the following section from above downward :

	FT	IN
CANNEL, slaty	0	6
COAL, bituminous	0	3
COAL, bituminous, resembling "curly cannel"	1	1
COAL, bituminous	0	6
	2	4

Near John McCarty's house on Droddy's Creek, about twenty feet below the opening on the Upper Cannel, there is an old opening quite fallen in that must have been on the Main Cannel, but its coal is said to have been "bituminous mixed with cannel."

The smooth cannel is cannel proper, the curly cannel is an intimate mixture of cannel coal and bituminous The curly is more highly prized, as it makes the best coal for domestic use The quality of both kinds is remarkably pure Besides the very great merits of the coal for domestic purposes, it is very valuable for making gas, owing to the large yield and high candle power of the gas, and the coal is therefore used as an "enricher" with bituminous gas coal.

The following are the results of an assay of the Peytona cannel coal, as reported by the Manhattan Gas Light Company of New York, in 1869 :

"Maximum yield of gas per ton of 2240 pounds—18,900 cubic feet of 82 66 candle power.

"At 10,000 feet per ton (standard yield) the illuminating power of the gas is equal to 41.16 candles

"Yield of coke per ton, 83 bushels, weighing 1880 pounds.

"One bushel of the hydrate of lime purifies 4510 cubic feet of gas.

"Analysis of the coal :

"Volatile matter	46.00
"Fixed carbon	41 00
"Ash	13 00
	100.00"

The cannel coal of the Main Bed has in some parts of the mine red ash, and in some parts white ash. At one place there is what they call "gummy coal" or "gum," red and white, said to be liquid when fresh, like syrup, thinner than cold molasses. Some of it when gathered dry in the mine looks like a rotten coal, and some of it like a bituminous powder.

In mining, the bituminous coal was thrown aside in the mine, and left there.

This bed is the same as the Factory Cannel Coal Bed of Lens Creek, but much superior to it in quality, as well as thickness, at the Peytona mines. It is a very irregular bed both in thickness and quality, and its unusual merits in these respects at Peytona gave especial value to the deposit there

The Factory Cannel Coal Bed was the most widely known of all the coals on Lens Creek and is the one formerly worked at the old oil factory on the Left Fork The section there at about twenty five yards inside the middle one of three drifts is as follows from above downward

		FT	IN	FT	IN
COAL bituminous		0	6	3	8½
Black slaty clay		0	9½		
Cannel		2	5		
Black iron ore	about	0	3		
		3	11½		

The bench of cannel however is said to yield only 1 foot 6 inches of good cannel the rest being wild cannel or cannel shale

The same bed was imperfectly opened in 1872 nearly opposite Nul y s house on the Left Fork of Lens Creek and had the following section from above downward

		FT	IN
No solid roof			
CANNEL partly good partly slaty all rather poor looking	about	3	0
Black carbonate of iron		0	2
Brownish gray sand rock at least		20	0
		23	2

The coal looks rather less pure than the Peytona mine cannel but that is perhaps owing to its being merely crop coal The thickness too could not be properly measured without a firm roof

The bed was opened also in 1873 near the schoolhouse of the Left Fork with the following section from above downward

		FT	IN	FT	IN
Shaly sandrock	about	29	0		
Black clay		0	1		
COAL		0	1		
Black clay		0	1		
Sand rock		2	0		
Gray shales		12	0		
Black soft slate		0	6		
COAL bituminous		0	4½	0	9
Clay		0	1		
COAL bituminous		0	3		
Bright CANNEL		0	0½		
Gray slaty clay		1	6		
Shaly sand rock	about	10	6		
		56	6		

The same bed apparently was imperfectly opened in 1872, near the head of Stewart Branch, and had the following section from above downward.

	FT	IN
Loam, no firm roof.................... ....about	2	0
Clay, mixed with coal slate, outcrop.. ...... "	0	6
Fire clay .... "	1	6
Coal, bituminous......	0	7
	4	7

The same bed was imperfectly opened too, in 1872, in Locust Hollow, east of the Right Fork, and had the following section from above downward:

	FT	IN
No true roof, but clay and wash.. ... about	2	0
Crop-coal....	0	7
Clay and wash.	0	6
Coal, bituminous	1	5
Fireclay .... about	0	1
Coal, bituminous.	0	7
	5	2

The same bed was well opened in 1872, above Asa Ferrel's house, near the southwest corner of the map, with the following section from above downward:

	FT	IN	FT.	IN.
Gray and brown shales	2	5		
Hard black slate........	0	1		
Gray and brown shales	0	6		
Coal, bituminous, good....	0	2	2	5
Cannel, good, but not curly. .	0	5		
Coal, bituminous, good	1	10		
Brownish-gray sand rock, exposed, about	0	6		
	5	11		

The place of the bed appears also to be indicated by an exposure of about three inches of bituminous coal a little more than 40 feet in level below the opening on Wood's Upper Coal at Perfater's Spring already mentioned.

The quality of the Factory Cannel Bed is plainly very variable, and its thickness extremely so. The bed thins out towards the Kanawha, near Brownstown and above, and can scarcely be found there at all, having but a few inches of thickness and no cannel. It may prove workable in some spots, especially near the factory, but is so thin and variable that it can hardly be counted on. The cannel lasts so long, when exposed to the weather, that bits of it are found all along the outcrop, which is therefore comparatively easy to follow on the ground; and can be looked for between the outcrops of Wood's Upper and Wood's Lower Coal.

Shoot Coal.—The Shoot Coal Bed, at Peytona, is so called from the opening near the foot of the shoot at the mines. The opening was closed and no longer accessible in 1872, but was said to have had the following section from above downward:

	FT	IN.
Coal, bituminous, good, hard	0	10
Slate	0	1½
Coal, bituminous, good, very hard, "breaks almost like anthracite"	2	6½
	3	6

The same bed is also said to have been opened a great many years ago, by Dr. DuBois, above the Blacksmith Bank, and found to have a thickness of over 4 feet, besides 3 inches of slate at 10 inches below the top.

The bed was opened in 1872, in Abshire's Hollow, opposite Abshire's house, with the following section from above downward.

	FT	IN
No solid roof.		
Coal, bituminous	2	10
Coal, "splint," or bony	0	6
	3	4

The bed was likewise opened in 1872, on Indian Creek, about 300 yards above Abshire house, and 50 yards below the mouth of Meadow's Fork of Indian Creek, and had the following section from above downward:

	FT.	IN.	FT	IN.
Gray shales.				
Soft black slate ... about	0	1		
Coal, bituminous	0	9	3	7
Slate	0	3½		
Coal, bituminous	2	6½		
	3	8		

On Lens Creek, the coal bed of Wood's lower mine (a drift some 20 feet long), on King's Branch of the Left Fork, is the same as the Peytona Shoot Coal Bed, and has the following section from above downward:

	FT.	IN.	FT.	IN.
Solid sand rock exposed ... about	4	0		
Coal, bituminous	1	0	3	8
Slate or clay ... about	0	0½		
Coal, bituminous	1	7		
Slate or clay ... about	0	0½		
Coal, bituminous	1	0		
	7	8		

The same bed was opened in 1872, near the schoolhouse of the left fork of Lens Creek, and had the following section from above downward:

	FT	IN	FT	IN
Brownish-gray sand rock, exposed, about	2	6		
COAL, bituminous, firm and good	2	9	4	0½
Bony coal or slate.........	0	0½		
COAL, bituminous, firm and good	1	3		
Slate, exposed..... .... about	0	3		
	6	9½		

The coal seems to be of fine quality.

The same bed was formerly opened at Fry's Coal Bank, still partially accessible in 1872, and had the following section from above downward.

	FT	IN
"Slate roof of unknown thickness."		
COAL, bituminous, very firm, good	3	3
"Slate bottom."		

Near the mouth of the drift the coal has a quarter inch of slate at a foot or fifteen inches from the bottom; but the slate is said to disappear further in.

The same bed was opened rather imperfectly on Stewart's Branch, nearly three quarters of a mile southwest of the forks of Lens Creek and had the following section from above downward.

	FT	IN.
Gray and black shales ... . about	10	0
Gray sand with some particles of coal mixed..... .	0	4
COAL, bituminous.............................. ..	2	0
Hard, brownish-gray sand rock.		
	12	4

The same bed, apparently, was opened in 1872, in Peels' Hollow, with the following section from above downward

	FT	IN
Loam.		
Brown shales.......................... ... .about	2	2
COAL, bituminous.................	0	6½
Fireclay.		
	2	8½

But, perhaps, the coal bed was not fully exposed; or possibly, by an error of the aneroid level, this may be the representative of the Blacksmith Coal Bed.

Imperfect openings of the same bed were also made nearly opposite Nuby's, on the Left Fork of Lens Creek, where only two feet are exposed in a crush of loose rocks; and near Asa Ferrel's, on the Right Fork of Lens Creek, where less than a foot of crop coal has been uncovered.

This coal bed is clearly the same as the bed formerly worked at the Winifrede Coal Co.'s main mine, less than a mile east of the main Parker tract. That mine was still accessible in 1872, with a little difficulty, and near the mouth of the drift gave the following section from above downward:

	FT	IN	FT	IN.
Brownish-gray, massive sand rock about	5	0		
Slate.	0	8		
Brownish-gray, massive sand rock. . . .	1	9		
Slate	3	0		
COAL, bituminous, firm and good........	2	9	4	6
Clay...........	0	3		
COAL, bituminous, firm and good........	1	6		
Shale, exposed................. .. about	1	0		
	15	11		

The quality of the coal, as well as the slate or clay parting, is extremely like what is found at the opening on Wood's Lower Bed (the Peytona Shoot Bed), near the schoolhouse of the Left Fork of Lens Creek, and at Fry's Coal Bank on Ketcham Branch and at other points. The identity was evidently recognized by Prof. Hall forty years ago.

The coal of Wood's Lower Bed on Lens Creek seems all to be of very fine quality, richer in gas than Wood's Upper Coal and somewhat less firm than that, though still very firm and capable of bearing handling very well. It is much liked as a domestic coal, and would probably be a good gas coal. It is unquestionably the same as the one of the Winifrede mines, the coal of which bears a very high reputation; and is probably the same in quality, since those mines are within a mile of the eastern edge of the main Parker tract. Besides, as already pointed out, the resemblance is very strong indeed.

The Winifrede Coal was supposed in 1872 to be also the same as the bed of the Coalburg mines, a couple of miles more distant up the Kanawha; but, in spite of the resemblance of the structure of the two beds and the quality of the coals and other arguments, Prof. White (Bulletin 65, p. 162), says that the Winifrede is seventy-five or one hundred feet lower than the Coalburg coal, reckoning from the Kanawha black flint. In that case it would seem that the Coalburg bed must be the same as Wood's Upper Coal, the Upper cannel of Peytona; but the distance apart in these two surveys is about one hundred and twenty feet, a difference hard to reconcile. The Shoot Bed of Peytona, Wood's Lower Bed of Lens Creek, seems hereabouts to be the most uniform in thickness and in quality of all the coals below the barren measures, and to be everywhere a very excellent, firm, bituminous coal and of workable thickness wherever it has been fully opened. Towards the Kanawha, outside of the tracts, it appears to be in two or three benches separated by layers of clay a foot or even more in thickness.

Blacksmith Coal.—The Blacksmith Coal at Peytona is so named for its purity and usefulness in the forge, and would seem to be very persistently of fine quality, since the same bed is called so in the northern edge of the State. It is, however, probably too thin to work at present, except for local use along the outcrop.

It was worked by a drift at the lower part of the Peytona mines, and had there the following section from above downward

		FT.	IN	FT.	IN
Brownish-gray sand rock	about	4	0		
Hidden.........	"	1	6		
Brownish gray, hard shales, exposed	"	0	6		
Soft shales.	"	0	3		
Coal, bituminous.....	"	0	2		
Bony coal or slate.....	"	0	1½		
Coal, bituminous	"	0	9	2	3
Slate	"	0	0½		
Coal, bituminous....	"	1	2½		
Clay, apparently					
		8	5		

The bed was opened also at Abshire's Coal Bank, on Indian Creek near Abshire's Hollow, with the following section from above downward :

		FT	IN.
Shaly sand rock, exposed...	about	5	0
Coal, bituminous, good.......		2	0
Fireclay, mixed with slate.			
		7	0

The same bed is opened, too. in Abshire's Hollow, back of his house, with the following section from above downward :

		FT	IN
Shales, exposed.......................	about	3	0
Shaly sand rock	"	2	0
Slate....	"	0	6
Coal, bituminous	"	2	1
Fireclay mixed with slate.			
		7	7

This bed at Lens Creek appears at about twenty feet below Wood's Lower Coal.

It would seem to be the bed opened in 1873 on Ketcham Branch, near the southeast corner of the map, in two places near together on opposite sides of the branch and about half a mile from its mouth At the upper southern one there was the following section from above downward

		FT	IN
Gray shale exposed	about	3	0
Black slate		1	6½
Gray shales		0	8½
COAL bitum nous and clay and slate in several layers mostly coal		1	2
Gray sl ales			
		6	5

At the lower northern opening of the two there was the following section from above downward

		FT	IN	FT	IN
Brownish gray sand rock	about	1	6		
Brown an l gray shales		5	0		
Black slate		1	5		
Gray shales		1	0		
COAL bituminous		0	3	0	7
Clay		0	2		
COAL bituminous		0	2		
		9	6		

The same bed seems also to have been opened on the Stewart Branch of the Left Fork some 500 yards above the mouth of the branch by a couple of old ruined drifts that expose a few inches only of the top of the coal with two or three feet of shales over it

JERROLD s COAL —Jerrold s Coal of Lens Creek seems not to exist at Peytons but to be represented perhaps by some three inches of black slate at the bottom of about twenty feet of apparently iron bearing brown shales just like those that overlie the bed on Lens Creek The black slate is exposed on the railroad about sixteen feet above the top of the lower shoot

The bituminous coal bed worked by Jerrold on the bank of the Left Fork of Lens Creek just below the mouth of Ketcham Branch has the following section there from above downward

	FT	IN	FT	IN
Loose blocks of sandrock				
Roof slate exposed	1	0		
COAL bituminous comparatively soft	0	7	3	3½
COAL bituminous much of it hard splint, but generally less hard than Wood s Upper Coal	2	8½		
	4	3½		

It would seem probable on the whole that it is the same bed that was worked at Mitchel s Coal drifts on the left fork of Lens Creek about 200 yards above the mouth of Ketcham s Branch though it is possible that the coal here is a local thickening of the small bed that occurs some fifteen feet below Jerrold's Coal. The section at Mitchel's drifts is as follows, from above downward:

		FT	IN
Slate, exposed . .	about	1	6
COAL, bituminous, less firm than Wood's Upper Coal, but of fair quality...... .	.. . .	3	1
"Slate floor."			
		4	7

The same bed apparently was opened at the old drift on the Ketcham Branch of the Left Fork of Lens Creek, near the mouth of the branch. The coal is partly covered at the bottom, but would seem to measure about two feet in thickness.

The Jerrold Coal is seen also at Mrs. Nuby's coal mine, a drift about six feet long on the Left Fork of Lens Creek, 300 yards below her house, with the following section from above downward:

		FT.	IN	FT.	IN
Shales, exposed	about	4	0		
COAL, bituminous, of fair quality		1	0	2	10¾
Clay		0	0½		
COAL, bituminous, of fair quality	.	1	10¼		
		6	10¾		

Two inches above the clay seam, there is, at least in places, another similar clay seam.

The same bed was worked with eight old drifts close together just across the creek, and had there the following section from above downward:

	FT.	IN
Sand rock, massive.		
Slaty shales and shaly sand rock with small iron-ore nodules.. . . . .about	15	0
COAL, bituminous, with two or three quarter-inch seams of black clay at about nine inches below the top, apparently 3,, 0 or more in one drift, in another, measured..	2	10
Slaty shales...	10	0
	25	0

The same bed is worked with a drift a dozen yards long at Myer's Coal Bank, close by the oil factory already mentioned, and has the following section from above downward:

	FT.	IN.	FT.	IN.
Brownish gray sand rock, massive, about	12	0		
Slate..............	0	6		
COAL, bituminous, good	0	9		
Black clay ....,.......	0	0½	2	8½
COAL, bituminous, good....	1	11		
	15	2½		

The same bed is also worked by Gus Hoffman on the Vinnie Lick Branch of the Right Fork of Lens Creek and has there the following section from above downward

	FT	IN
COAL bituminous	0	6
Clay	0	0⅛
COAL bituminous	8	0
	8	6⅛

The bed has been worked too by a drift on the opposite (west) side of the Right Fork of Lens Creek back of Gus Hoffman's house and has there the following section from above downward

		FT	IN
Brownish gray shaly sand rock	about	8	0
Shales with iron nodules		1	6
COAL bituminous		2	1
		11	7

The bed was imperfectly opened on the Right Fork of Lens Creek opposite the mouth of Orchard Hollow and a quarter of a mile above the mouth of Vinnie Lick Branch and had the following section from above downward

		FT	IN
Shaly sand rock with some nodules of impure iron ore	about	6	0
COAL bituminous good but much weathered at least	about	1	9¼
Dark shales		5	0
		12	9¼

Half a foot of the top of the coal bed is exposed under the shales near Mr Hoffman's opposite the mouth of Big Hollow on the Right Fork of Lens Creek

The bed was opened in 1872 in Locust Hollow near the east bank of the Right Fork of Lens Creek and had the following section from above downward

	FT	IN	FT	IN
Clay shales no solid roof	2	0		
COAL bituminous mostly hard and good	1	6¼	3	0¼
Clay	1	0		
COAL, bony	0	6		
	5	0¼		

Another imperfect trial pit on the same bed some twenty yards to the south gave about the same measurements but some of the lower bench seemed to be like cannel

The same bed is at least partially exposed where it finally passes southward beneath the bottom of the valley of the Right Fork of Lens Creek, at the mouth of Rise Hollow. The coal there is partially concealed by muddy water and perhaps rubbish in the hole, but would seem to be only 1,. 6 or two feet thick, with only two feet of wash for a cover. The wash is stripped off, and the coal dug out The coal is firm and in large lumps, bituminous, of good quality and much liked by the country people.

The coal at Jerrold's, Hoffman's, Nuby's and Myer's mines, and at Rise Hollow is of good quality, but not equal to Wood's Upper and Lower coals. It is less firm, especially the upper six inches, than either of them; but the greater part of the bed is far from being tender. The quality in fact seems to be on the whole pretty fair The thickness would seem to be rather variable, and it may prove to be unworkable at present in some parts of the tracts It not only disappears at Peytons, but on the Kanawha above Brownstown would seem to be hardly of workable thickness, or only two feet and a half, though worked a little at some points.

VICKER'S COAL.—Opposite the mouth of Vicker's Branch, on the Left Fork of Lens Creek, at the lower end of the eight drifts on the Jerrold Coal, there are two old drifts on a coal, a dozen or fifteen feet lower; and, for want of a more suitable name, it may be called Vicker's Coal. The coal is no longer exposed for measurement here, but seems to have been perhaps two feet thick.

The same bed was worked at an old drift about fifteen feet below Jerrold's old coal opening on the Left Fork of Lens Creek, two hundred and fifty yards below the mouth of Ketcham Branch. There also the drift has fallen in so as to be inaccessible and leave the coal unexposed. The thickness seemed to have been perhaps two feet.

The bed may probably be the same as the one exposed at Peytons, nine feet below the top of the waterfall below the lower shoot. It has there the following section from the top of the waterfall downward.

	FT	IN
Brownish-gray sand rock, very cross-bedded..... ...	9	0
COAL, bituminous............	0	8
Brownish-gray sand rock (?)		
	9	8

It is probable that the coal bed was of greater thickness than that, at the drifts on Lens Creek, or it would not have been opened for working at all; but as it seems to have been little worked compared with the Jerrold Coal just above it, there is no probability that it was more than the two feet thick it seems to have been.

It is barely possible that the coal of Mitchel's old drifts on Lens Creek just above the mouth of Ketcham Branch may be the Vicker's bed; and it was so supposed probable in 1873; but in that case it would have been only quite locally thicker there. It seems on the whole very much more likely that Mitchel's coal was the same as Jerrold's.

COMPARISON WITH THE NORTHERN WEST VIRGINIA SECTION

According to Prof. J. J. Stevenson (*Trans. Am. Phil. Soc*, Vol xv, pp. 17–31, 1873), the section of the carboniferous rocks of a portion of Monongalia and Marion counties, in the northern edge of West Virginia, near the southwest corner of Pennsylvania, is as follows, from above downward.

UPPER COAL GROUP—MONONGAHELA RIVER SERIES

		MEAN.			
	FT	FT.	IN	FT	IN
1. Sandstone, "Waynesburg"	30–40	35	0	43	0
2. Shale..................	1–15	8	0		
3. COAL, "Waynesburg"....	6–9	7	6		
4. Sandstone................	15	15	0	194	6
5 Shale....................	8	8	0		
6. Limestone................	5	5	0		
7. Shales and sandstone......	20	20	0		
8 Limestone and shale......	30	30	0		
9. Sandstone and shale......	33	33	0		
10. Limestone................	6	6	0		
11. Sandstone................	15	15	0		
12. Limestone................	7	7	0		
13. Sandstone................	10	10	0		
14. Limestone................	8	8	0		
15. Sandstone and shales.....	23	23	0		
16. Shale....................	1–25	12	6		
17. COAL, "Sewickley"......	4½–6	5	8	5	8
18. Shale....................	5–8	6	6	44	6
19 Limestone................	9	9	0		
20. Sandstone................	4–10	7	0		
21. Limestone................	22	22	0		
22. COAL, "Redstone".......	4–5	4	6		
23. Fireclay..................	1	1	0	39	0
24. Limestone................	12	12	0		
25. Shale....................	5–12	8	6		
26. Sandstone................	0–35	17	6		
27. COAL, "Pittsburgh"......	7–14	10	6	10	6
28. Fireclay..................	3	3	0	20	0
LOWER BARREN GROUP—BARREN MEASURES.					
1. Shale with iron...........	14	14	0		
2. Limestone................	2–4	3	0		
3. COAL....................	1½–2	1	9	1	9

		MEAN			
	FT	FT.	IN	FT	IN.
4. Shale	3	3	0	86	6
5. Sandstone	25	25	0		
6. Shales	8	8	0		
7. Limestone	3	3	0		
8. Shale with iron	4½	4	6		
9 Limestone	1½	1	6		
10. Shales and shaly limestone	22	22	0		
11 Limestone	1½	1	6		
12. Shale	18	18	0		
13. COAL	1½–2	1	7½	1	7½
14. Sandstone	10–35	17	6	17	6
15. COAL	¾–1¼	0	11½	0	11½
16. Limestone	8	8	0	91	0
17. Shales, olive	10	10	0		
18. Limestone	3	3	0		
19. Shales, olive	12	12	0		
20. Sandstone	40	40	0		
21. Conglomerate	0–6	3	0		
22. Sandstone	15	15	0		
23. COAL	3½–4	3	9	3	9
24. Shales, variegated, with some shaly sandstone	33½	33	6	63	0
25. Sandstone	1–4	2	6		
26. Shale, calcareous and fossiliferous	2–4	3	0		
27. Shale, variegated, fossiliferous	24	24	0		
28. COAL	½–1½	0	11	0	11
29 Limestone	5	5	0	139	6
30 Shales, variegated, with iron	20	20	0		
31. Sandstone	10–20	15	0		
32. Shales with iron	10–15	12	6		
LOWER GROUP—ALLEGHENY RIVER SERIES.					
1. Sandstone, "Mahoning"	75	75	0		
2. Shales	12	12	0		
3. COAL	1⅓	1	4	1	4
4. Shales	1–25	13	0	13	0
5 COAL	4–5	4	6	4	6
6. Shales	10	10	0	10	0
7. COAL	1	1	0	1	0
8. Sandstone	5	5	0	49	6
9. Shale	10	10	0		
10. Limestone, "ferriferous"	4–5	4	6		
11. Shale	30	30	0		

		MEAN			
	FT	FT	IN	FT	IN
12. COAL	3½	3	6	3	6
13. Sandstone and shale .	20–30	25	0	25	0
14. COAL, "Blacksmith". .	2–3	2	6	2	6
15. Shale	15–20	17	6	70	0
16. Sandstone, "Tionesta"	25–30	27	6		
17 Shale.	25	25	0		
18. COAL.....	1¾	1	9	1	9
19. Sandstone.. . .	4	4	0	4	0
20. COAL....... .	1	1	0	1	0
21. Shale	10	10	0	10	0
Great conglomerate, Penna. No XII. . about	350			350	0

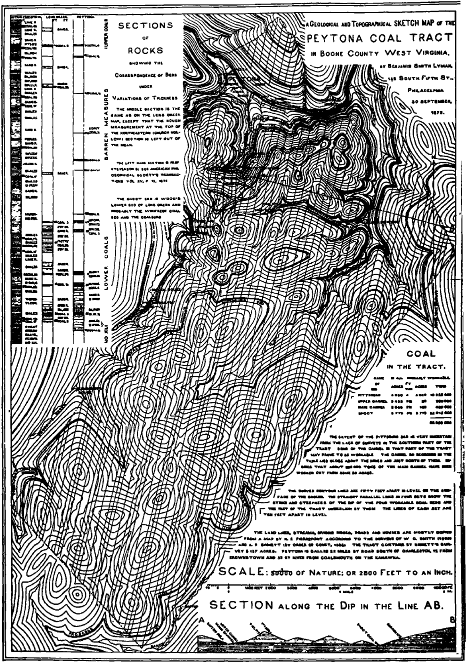
The following table of sections shows the coal beds and the intervals between them at Peytona, and in several parts of the Lens Creek field, as well as an average of the whole Lens Creek field, in comparison with the corresponding beds of Prof. Stevenson's section for the northern edge of the State, as just given.

The columnar sections drawn on the two maps show the correspondence of the coal beds still more clearly.

IDENTIFICATION OF THE COAL BEDS.

Comparing these sections with the sections given by Prof. I. C. White in his Bulletin No. 65, it appears that the six-inch coal about twenty-three feet below the Pittsburgh Bed at Peytona is the little Pittsburgh Bed of Fayette county, Pa ; the Slate Vein would apparently correspond to the Little Clarksburg Coal, likewise slaty at Clarksburg, W. Va ; the three-inch bony coal about 200 feet below the Pittsburgh Bed at Peytona (or possibly the five-foot coal fifty-five feet lower) would correspond to the Elk Lick Coal of the Pittsburgh, Allegheny County and Fayette County region ; the six-inch bituminous coal at nearly twenty feet above the Upper Cannel or Wood's Upper Coal, would be the Upper Freeport Bed ; the Main Cannel, or Factory Cannel, would be the Middle Freeport Bed ; Stevenson's coal bed No. 7 would be the Lower Freeport Bed ; the Shoot Coal, or Wood's Lower Coal, or the Winifrede Coal, would be the Middle Kittanning Bed ; the Blacksmith Coal would be the Lower Kittanning ; Jerrold's Coal would be the Clarion Bed ; and Vicker's Coal would be the Brookville Bed.

The leveling of the surveys was done partly with the vertical circle of a transit, partly with a hand level and partly with an aneroid ; and though not perfectly exact, was no doubt quite sufficiently so to confirm the identification of the coal beds and to prove that the general sections of the surveys agree very strikingly with the one of northern West Virginia.



A Geological and Topographical SKETCH MAP of the
PEYTONA COAL TRACT
in Boone County West Virginia,
by Benjamin Smith Lyman,
1?? South Fifth St.,
Philadelphia
30 September,
1872.

SECTIONS
of
ROCKS
showing the
Correspondence of Beds
under
Variations of Thickness

The middle section is the same as on the Lens Creek map, except that the rough measurement at the top of the northeastern (Church Hollow) section is left out of the mean.

The left hand section is from Stevenson's; see American Philosophical Society's Transactions vol. XV, p. [illegible], 1875.

The Shoot bed is Wood's lower bed of Lens Creek and probably the Winifrede coal bed and the Coalburg.

COAL
IN THE TRACT.

Name of bed	In all. Acres	Probably workable. Ft. thk.	Acres	Tons
Pittsburg	3 950	4	3 000	10 [illegible] 000
Upper Cannel	3 435	[illegible]	30	[illegible] 000
Main Cannel	3 640	[illegible]	160	[illegible] 000
Shoot	3 770	[illegible]	3 770	[illegible] 000
				[illegible] 000

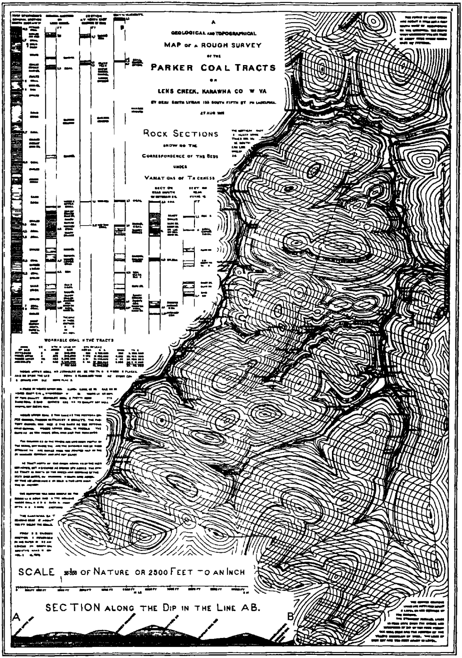
The extent of the Pittsburg bed is very uncertain from the lack of surveys in the southern part of the tract. Some of the Cannel in that part of the tract may prove to be workable. The Cannel so reckoned in the table lies close about the mines and just north of them. Besides that about [illegible] tons of the Main Cannel have been worked out from some 30 acres.

The curved contour lines are fifty feet apart in level on the surface of the ground. The straight parallel lines in four sets show the strike and steepness of the dip of the four workable coal beds and the part of the tract underlain by them. The lines of each set are ten feet apart in level.

The land lines, streams, divide ridges, roads and houses are mostly copied from a map by H. E. Pierrepont according to the surveys of W. D. Smith ([illegible]) and A. F. Bennett (by order of court, [illegible]). The tract contains by Bennett's survey 5 137 acres. Peytona is called 22 miles by road south of Charleston, 12 from Brownstown and 35 by river from Coalsmouth on the Kanawha.

SCALE: [illegible] of Nature; or 2800 Feet to an Inch.

SECTION along the Dip in the Line AB.


A
GEOLOGICAL AND TOPOGRAPHICAL
MAP OF A ROUGH SURVEY
OF THE
PARKER COAL TRACTS
ON
LENS CREEK, KANAWHA CO W VA
BY BENJ SMITH LYMAN 135 SOUTH FIFTH ST PHILADELPHIA
27 AUG
ROCK SECTIONS
SHOWING THE
CORRESPONDENCE OF THE BEDS
UNDER
VARIATIONS OF THICKNESS
WORKABLE COAL IN THE TRACTS
SCALE 1/30000 OF NATURE OR 2500 FEET TO AN INCH
SECTION ALONG THE DIP IN THE LINE AB.
A
B

	STEVENSON N. FORK W. A.		PEYTONA GENERAL		LENS CR. GENERAL		NEAR FERRELL'S E. F. LENS CR.		NEAR MOUTH OF KETCHAM BR.		NEAR DRURY'S L. F. LENS CR.		N. E. COR. MAP & CHURCH HOL.	
	FT	IN	FT	IN	FT	IN	FT	IN	FT	IN	FT	IN	FT	IN
COAL bed Pittsburgh	10	6	4	0	5	0					5	6	4	9
Interval	20	0	23	0										
COAL bed	1	9	0	6	89	0					89	0	57	0
Interval	86	6	85	0										
COAL bed Slate Vein	1	7½	0	4	3	0					3	3	3	0
Interval	109	5½	90	0										
COAL bed No. 23	3	9	0	8										
Interval			55	0										
COAL bed			5	0	300	0					303	0	300	0
Interval	203	5	120	0										
COAL			0	6										
Interval bed			16	4										
COAL Upper Cannel	1	4	2	6	3	0	2	6	3	4	3	6	1	3
Interval	12	6	18	3	44	0	26	9	61	0	47	0	50	0
COAL bed Main Cannel	4	6	2	10	3	0	2	6	0	9	3	0	0	6?
Interval	10	0												
COAL bed No. 7	1	0	93	6	67	0	68	0	63	0	66	0		
Interval	49	6												
COAL bed Shoot Bed	3	6	3	6	3	8	0	6	4	0	3	0+		
Interval	25	0	23	0	23	0					23	0		
COAL bed Blacksmith	3	6	3	0	0	4	78	0	93	4	0	3		
Interval	70	0	63	0	61	0					66	0		
COAL Jerrold's	1	9	(slate)		3	0	2	0?	3	4	3	0		
Interval	4	0	37	0	14	0			14	0	14	0		
COAL Vicker's	1	0	0	8	2	0?			2	0?	2	0?		
	623	7	644	9	602	0	180	3	244	9	630	6	416	6

The Ethics of Solomon.

By J. Cheston Morris, M.D.

(*Read before the American Philosophical Society, October 5, 1894.*)

Probably at no period of human history, unless it be in our own time and case, do we read of such changes as came over the Hebrew nation in the course of the century covering the reigns of Saul, David and Solomon.

For three or four centuries preceding, the land of Palestine had been occupied by the twelve tribes who took possession of it under the leadership of Joshua, the successor in command of Moses the great lawgiver. Trained in Egyptian knowledge and civilization, we should naturally look for marks of the impress of Egyptian modes of thought and expression in their writings, and accordingly we do find much that is to be explained by their contact with, and departure from, this phase of human development as illustrated by the monuments and mummies which have been and are now so carefully studied. A pastoral and agricultural people, living in detached communities, associated more or less closely by consanguinity and common dangers, and with a worship which separated them from the idolatrous nations surrounding them, they seem to have enjoyed varying degrees of prosperity and freedom under the judges or rulers who arose among them from time to time. The ancient empire of the Hittites had crumbled and disappeared; the rival Assyrian and Egyptian empires had alternately prospered and waned, and were then, as they continued to be, in frequent contact and struggle for supremacy. Along the east coast of the Mediterranean were powerful cities of Philistines and the commerce-loving Tyrians and Sidonians. As in after ages, the rich and fertile plains, the valleys and mountain fastnesses of the land of Canaan, Gilead, Bashan and Moab produced food and cattle in enormous quantities for the supply of these neighboring nations, and caravan routes were well established along the coast and across the Arabian and Syrian deserts. By these communication was made and exchange effected between the products of the valleys of the Nile and the Euphrates; while by the commerce of Tyre, the Iberian peninsula and possibly the shores of Albion were brought into intercourse with far Cathay, as we may infer from the length attributed to the voyages of the navies of Hiram and Solomon and the cargoes with which they were freighted. But with the movements or interests of their neighbors the Hebrews hitherto had had little concern—they might hardly even have had more title to be considered as a nation than have to-day the wandering Bedouin bands that are the sole permanent inhabitants of Arabia. Their territory was raided by Moabite, Amalekite or Philistine: no advance in arts or sciences took place among them; and even their monotheistic faith seemed likely to die out, as it degenerated into a superstitious reverence for the Ark, or was overlaid with the idolatry of the surrounding peoples. After the capture of their great Palladium by the Philistines, they became the slaves of the latter, until, under the guidance of Samuel, Saul raised the standard of revolt, blew the trumpet in Gibeah with the shout, "Let the Hebrews hear" Successful in driving off the oppressing bands of the Ammonites, he was soon surrounded by large numbers of his countrymen now roused to strike for their liberty, he organized them and led them to victory But the crowning achievement of the war with the Philistines which ensued was not his, but that of "a youth, ruddy and of fair countenance," who with sling and stone slew in mortal combat the challenging giant of the Philistine army, and thus became, in accordance with Saul's offer, his son in law The kingdom of the Hebrews was then successfully established, and by the prowess of its warriors gained respectful consideration among its neighbors The subsequent madness of Saul, his jealousy and banishment of David, and his death in his last great battle with the Philistines, we need not stop to consider, except to note the indignation which Nabal's sneer, "There be many *slaves* nowadays who have run away from their masters," aroused in David, as an index of how the movement of the Hebrews was regarded by the wealthy sheep master of Carmel. The death of Saul was in a few years followed by David's public recognition as king of the united nation—by the capture of Jerusalem from the Jebusites and its establishment as his capital, whence he waged war after war against the surrounding Moabites, Edomites and Ammonites, extending his territories, carrying off immense booty, and levying heavy imposts on his subjugated enemies Of all this we read only incidental and fragmentary allusions, yet sufficient to enable us to trace the rise of the nation to power and wealth; so that we are not surprised at the alliance of Pharaoh's daughter with his son Solomon If David's character as that not only of the sweet singer of Israel, but a large-hearted, earnest man and devoted servant of God, should interest us, not the less should that of his son and successor. Born and reared amid all these commotions and developments, and doubtless trained carefully by Nathan and the other counsellors of his father, and impressed with the duty laid upon him to consolidate and strengthen the new kingdom, he evinces a spirit of wisdom and discretion, an earnest study of the conditions of his life work that may well win our admiration. The building of the temple and the palace for which preparations had been made during his boyhood would naturally draw to Jerusalem the best skill and thought of the time; for it was well known that neither means nor desire were wanting to make them what indeed they were, worthy of rank among the wonders of the world. Then also the overland commerce between Egypt and Assyria traversing such an extent of Solomon's dominions, and fostered by him by building fortresses and outposts to protect the caravans as they came from Damascus to the shores of the Mediterranean, would bring such an amount of business to Jerusalem that we can readily understand how he made silver and gold as common as iron and stone in his rapidly growing capital. Judicious alliances and treaties, his reputation for justice and fairness, and the prosperity of the nation naturally attracted men of science and thought around him just as in later days they were to be found at the court of Haroun al Raschid Then the public works undertaken and carried out so magnificently with the aid of skilled men from Tyre for instance would have brought together the architects and mechanicians the sculptors and brassfounders and many other artisans whose occupations and achievements must have seemed most marvelous to the nation of shepherds and herdsmen We read in the sacred history of the brassfoundings and castings made by some of these men and can readily comprehend after clouds of smoke from the furnaces had filled the valley and plain of the Jordan and forms of beauty and grace came from the moulds prepared by these foreigners how tales of genii and afreets spread among the people and Solomon s ring became invested with the magical powers which it possessed in the imaginations of the East We can see the genesis of stories like that of Aladdin But amid all this concourse of men of thought and action the guiding spirit is that of Solomon Of studious reflective observant and judicial turn of mind we find recorded among his works not only proverbs and poems but treatises on natural history We are informed that he *spake of trees from the hyssop to the cedar of Lebanon* i e from mosses to conifers and of beasts and fowl creeping things and fishes Though these treatises are lost we may judge of his accuracy from such allusions as are made in Proverbs and Solomon s Song to the habits and actions of both animals and men

We may then easily picture to ourselves this powerful king gathering around him a sort of Academy of Sciences or Royal Philosophical Society before which would come many and varied subjects of interested discussion among representative men of the differing civilizations of the period Before such an Assembly or *εκκλησια*, or acting perhaps as its Secretary or Reporter or Clerk *εκκλησιαστης*, we may imagine him reading a paper on the theme of man his object and destiny in the universe and how he can attain to his best development his highest good We may suppose Egyptian Materialism Assyrian Fatalism and Tyrian Commercialism or Opportunism well represented in the audience either taking part in the discussion or having their respective views stated to be criticised and shown to be partly erroneous or insufficient and followed by the statement of his own solution, and the application of it to the whole problem This is to be found in Ch viii 1 Wisdom maketh a man s face to shine ' If we look to Solomon s conception and impersonification of Wisdom as given in Proverbs viii and ix, and think of the contrast he draws between it and the false woman ' as Socrates ages after did between the true and false reason, and recall the devotion of the Alexandrian school to the Holy Wisdom which led to the opening words of John s Gospel in which the same wisdom is called The Word—*Λογος*—the Son of God and afterwards to the erection of ' Hagia Sophia " at Constantinople we shall it seems to me, gain the clue so much sought after to this Book of Ecclesiastes It then all comes into logical form as a grand discussion on the theme of what is profitable for man, and what should be the ruling aim of his life ; and the conclusion is given in the last verses.

The propositions which Solomon maintains are:
The omnipotence of God :
The future life of man and
The judgment after death.

The whole is cast into the form of a poem, as may easily be seen by putting the verses of the Authorized Version in parallelism, or by following the Septuagint translation, in which I find this already done. I have also tried to analyze the differing arguments and sentiments, and to attribute them respectively to an Egyptian, an Assyrian, and a Tyrian speaker, and to Solomon in reply, concluding with the verdict of the Assembly as given by its "Shepherd" or presiding officer.

As to the success of such an effort and how far it explains the whole book, I leave to the candid reader and critic to determine. The "materialistic" views of esoteric Egyptian philosophy, the successive passage of earth, air, fire and water into each other, the perpetual round of the forces of Nature, are first given, then the dark "fatalism" of the East, "to everything there is a season," then selfish "opportunism," are successively discussed, and dismissed as insufficient or unworthy explanations of this "sore travail of the sons of men." Then comes the solution, to walk in the fear of God, in the wisdom of God, in the hope of a life beyond, followed by the beautiful peroration, and summing up of the whole.

The composition of the book is easily explained by the circumstances given, and its argument is complete, without any necessity for supposing later Epicurean or Stoic or Platonic influences. The problems of human existence had been thought out far beyond these in the East long before, as we find from Pythagoras, and the monumental evidences we are discovering in the present era of investigation among the remains of antiquity.

Brugsch Bey, in 1876, drew for me a schema which represented what he considered the esoteric Egyptian philosophy four altars in profile, dedicated to earth, fire, air and water respectively, while a circle above indicated the perpetual change of matter from one of these forms into another. Each is worshiped as divine, and each has both a male and a female name. From this I took my concept of the views of the Egyptian. Omar Kayam's celebrated "Rubayat" furnished me with that, of the Assyrian, while the Chinese commissioner, Hon. Fung Kwang Yu, in his statement before the Parliament of Religions, at Chicago, of the doctrines and modes of worship of the followers of Confucius almost exactly echoes the sentiments of my Tyrian.

Since writing the above I have availed myself of the kind criticisms and suggestions as to several passages of my friends : Rt. Rev. O. W. Whitaker, Dean Bartlett, Dr. McVickar, Prof. Morris Jastrow, Jr., Dr. W. F. Brand and Dr. Benjamin Lee, to whom, as well as to Rev. Mr. Elwyn and Rev. Dr. Cattell, I hereby return my thanks and acknowledgments. While

Jerome Luther Desvœux and Herder have each suggested some such colloquy as I have proposed their exact views were unknown to me until this article was in print and I would submit that Herder's very similar division in many instances is an argument in favor of the hypothesis

ECCLESIASTES

1 The words of the Ecclesiast the son of David (the) king of Israel in Jerusalem *

SOLOMON

2 Perplexity of perplexities said the Ecclesiast all is perplexity †
3 What profit to the man in all his labor
In which he labors under the sun ?

EGYPTIAN

4 A generation goes and a generation comes
And the earth has stood for ever
5 The sun rises and the sun sets
And hastes to its place (again)
6 It rising there moves toward the South
And circles (again) toward the North
The wind goes in a circling of circles
And returns upon its circles
7 All the streams run into the sea
And the sea is not filled
To the place where the streams run
Thither they return to flow
8 All words are feeble
A man shall not be able to speak it
And the eye shall not be filled with seeing
And the ear shall not be satisfied with hearing
9 What has been ? that is what shall be
And what has been done ? that shall be done
And there is no new thing under the sun
10 Who shall speak and say Behold this is new
It hath already happened in the ages before us
11 There is no remembrance of the first things,
And to the latest things there shall be no remembrance
Among those that shall be born at the last

SOLOMON

12 I the Ecclesiast became King
Over Israel in Jerusalem

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* Translated from the Septuagint

† See Liddell & Scott for true rendering of ματαιοτης

13 And I gave my heart to seek out
And to observe in wisdom
Concerning all things happening under heaven
For a difficult task God has given to the sons of men
That they should be exercised in it
14 I saw all the deeds done under the sun
And behold all is perplexity and grasping of wind
15 The scattered cannot be arranged in order
And that which is lacking cannot be numbered
16 I spoke in my heart to say
Behold I am increased and have added wisdom
Above all who were before me in Jerusalem
And I gave my heart to know wisdom and knowledge
17 And my heart considered many things
Wisdom and knowledge parables and understanding
I knew that even this is a grasping of wind
18 For in abundance of *wisdom* is an abundance of knowledge
And the one adding knowledge adds pain
2 I said in my heart Come I will prove thee in pleasure,
And see into the good and lo even this too is perplexity
2 I said to laughter, It is excess
And to pleasure Why doest thou this?
3 And I observed whether my heart would heat my flesh as wine
And my heart walked in wisdom
And to seize upon pleasure
That I might see what is good for the sons of men
What they should do under the sun
All the days of their life
4 I increased my working
I builded me houses I planted me vineyards
5 I made for myself gardens and parks
And I planted in them every tree of fruit
6 I made for me fountains of waters
To water thence the forest producing the trees
7 I bought me men slaves and women slaves
And house servants were born to me
And even the possession of herd and flock was great
Beyond all that had been before me in Jerusalem
8 I gathered me even silver and gold,
And the treasures of Kings and of the countries
I made for myself songsters and songstresses
And luxuries of sons of men, cupbearer and female cupbearers
9 And I was increased, and added
Beyond all who were before me in Jerusalem
And indeed my wisdom remained with me
10 And all which my eyes desired I withheld not from them

I refused not my heart any pleasure
Because my heart rejoiced in all my labor
And this was my portion from all my labor
11 And I beheld all the works which my hands had wrought
And on the labor I had labored to do
And behold all was perplexity and grasping of wind
And there is no profit under the sun
12 And I looked to consider wisdom
And excess and folly
For what man shall follow (i e excel) after this plan ?
Such he (the King) hath done (already)
13 And I saw that wisdom excels folly
As light excels darkness
14 The eyes of the wise are in his head
And the fool walks in darkness
And I know even I
That one end shall meet them all
15 And I said in my heart
As the ending of the fool
Shall there be an ending even to me
And wherefore was I wise ?
I spoke moreover in my heart
That even this is perplexity
Because the fool speaks from excess
16 That there is no memory of the wise
Any more than of the fool through Eternity
Because in the coming days all shall be forgotten
And how dies the wise man as the fool ?
17 And I hated life
For it was evil to me,
The work done under the sun
For all is perplexity and grasping of wind
18 And I hated all my labor
In which I labor under the sun
19 For I shall leave it to the man who comes after me
And who knows whether he shall be wise or a fool ?
And whether he shall have authority in all my labor
In which I have labored and been wise under the sun ?
This indeed is perplexity
20 Then I turned to detach my heart
From all my labor which I had labored under the sun
21 For there is a man, whose labor is in wisdom
And in knowledge and in manliness
And the man shall give his portion to one who did not labor in it !
This is indeed perplexity and great injustice,
That it happens thus to the man
In all his labor and the grasping of his heart

22 What shall be to the man in all his labor
And in the grasping of his heart
In which he labors under the sun?
23 For all his days are a struggling
Of pains and of his rage,
And even in the night his heart sleeps not—
This indeed is perplexity

EGYPTIAN

24 There is no good for man (except)
What he eats and what he drinks,
And what good he shows his soul in his labor

SOLOMON.

Even this I see is from the hand of God
25 For who eats and drinks without Him?
26 For to the good man before His Presence
He gives wisdom, knowledge and happiness:
And to the wicked He has given a struggle to add and to gather,
That He may give to the good man before the presence of God
So that even this also is perplexity and grasping of wind.

ASSYRIAN.

3 Time is for all things
And a season to every deed under heaven
2 A season to be born, and a season to die
A season to plant, and a season to pluck up the planted.
3 A season to kill, and a season to heal·
A season to destroy, and a season to build;
4 A season to weep, and a season to laugh:
A season to mourn, and a season to dance:
5 A season to throw away stones, and a season to gather stones.
A season to embrace, and a season to be far from embracing:
6 A season to seek, and a season to lose:
A season to keep, and a season to throw away:
7 A season to rend, and a season to sew.
A season to be silent, and a season to speak:
8 A season to love, and a season to hate:
A season of war, and a season of peace.

SOLOMON.

9 What profit to the worker in the things which he works?
10 I beheld all the struggle
Which God has given to the sons of men,
That they should struggle in it.

ASSYRIAN

11 Everything which He has made is beautiful in its season
He hath even set all the eternity in their heart
That man should not find out the doing which God does
From the beginning even unto the end
12 I know that there is no good thing among them
But to rejoice and do good in his life
13 And indeed every man who eats and drinks
And sees good in all his labor
This is the gift of God

SOLOMON

14 I know that all things which God hath made
These things shall be forever
To Him it is impossible to add
And from Him impossible to take away
And God has made it
That men should fear before His Presence
15 What has been already is
What shall be has happened already
And God shall seek the driven away
16 And yet I saw under the sun the place of judgment
There was the impious
And the place of the righteous
There was the pious
17 And I said in my heart
God judges the righteous and the impious
For there is a season for everything
And for every deed there
18 I said in my heart concerning the talk of the sons of men
That God judges them
And to show that they are (but) beasts

ASSYRIAN

19 And indeed the end of the sons of men and the end of the beasts,
There is one end to them (both)
As the death of this so the death of that
And one breath is in all
And how doth man excel the beast?
Nothing for all is perplexity
20 All (go) to one place
All came from the dust,
And all shall return to the dust
21 And who has seen the spirit of the sons of man,

Whether it ascends?
Or the spirit of the beast,
Whether it descends below into the earth?
22 And I saw that there is no good for man
But that he should rejoice in his works,
Because this is his portion :
For who shall bring him to see
In what it shall consist after him?

SOLOMON

4 Then I turned, and behold all the oppressions,
That are done under the sun.
And, behold, the tears of the oppressed,
And there is no one comforting them
And in the hand of those oppressing there is power,
But there is no one comforting them
2 And I praised the dead who are already dead
More than the living who are yet alive
3 Yea good above these two
Is he who has not yet been,
Who hath not seen all that is done,
The evil done under the sun
4 And I beheld all the labor,
And all the manliness of the doing,
That this is envy of a man from his fellow
This indeed is perplexity and grasping of wind.

TYRIAN.

5 The fool folded his hands
And ate his own flesh
6 Better is a handful of rest
Than two handfuls of labor and grasping of wind

SOLOMON

7 And I returned, and saw perplexity under the sun.
8 There is one, and there is not a second
For there is neither son nor brother to him :
And there is no end to all his labor .
For his eye is not sated with wealth
And for whom do I labor .
And deprive my life from goodness?
This at least is perplexity, and an evil struggle.

TYRIAN.

9 Two are better than one :
To them is a good reward in their labor :

10 For if they fall, one shall raise his fellow
But woe to the one when he shall fall,
And there is not the second to raise him
11 And indeed if two sleep together they have warmth
But the one, how shall he be warmed?
12 And if one be overcome,
The two shall stand against him (their enemy),
And a threefold cord shall not be quickly broken.

SOLOMON

13 Better is a poor and wise servant (or youth)
Than an old and foolish King
Who knows not to give heed any longer
14 For out of the house of bondsmen (this one) shall come forth to reign,
While even in his own kingdom (the other) has become poor
15 I saw all the living under the sun
Walking with the youth the second (or successor),
Who shall stand instead of him
16 There is no end to all the people,
To all that were before them ·
And indeed the last shall not rejoice in him
So that even this is perplexity and grasping of wind.

TYRIAN.

17 Keep thy foot as thou walkest to the house of God,
And let thy sacrifice be (to be) near to hear
Rather than the gift of fools,
For they know not that they do evil.
5 Haste not with thy mouth,
And let not thy heart make haste
To bring a word before the Face of God ·
For God is in the heaven above,
And thou upon the earth
Therefore let thy words be few.
2 For a dream comes in abundance of trial,
And a voice of a fool in abundance of words
3 According as thou shalt vow a vow unto God,
Delay not to pay it.
For there is no pleasure in fools.
Pay therefore what thou shalt vow.
4 Better for thee not to vow,
Than to vow and not to pay.
5 Let not thy mouth make thy flesh to sin,
And say not before God's Face that it is a mistake:
Lest God should be angry at thy voice,
And destroy the works of thy hands.

6 For (it is) in abundance of dreams and perplexities, and of many words,
That thou fearest God

SOLOMON

7 If thou seest the oppression of the poor,
And the ravaging of judgment and justice in a land,
Admire not this thing
For there is a Lofty One to watch over the lofty,
And there are loftier ones than these
8 And the abundance of the land over all (others)
Is the king of a well tilled field
9 The lover of silver shall not be satisfied with silver
And who has loved their begettings in (its) abundance?
This indeed is perplexity

TYRIAN

10 In abundance of goods those eating them are multiplied
And what manliness to him from it?
That it is the government of seeing (it) with his eyes
11 Sweet is the sleep of the slave,
Whether he eat little or much .
12 But to the one abounding in wealth
There is that prevents him from sleep

SOLOMON

13 There is a sore evil which I have seen under the sun
Riches kept for one's own for evil to himself,
And that riches is destroyed in an evil struggle ;
And he hath begotten a son, and there is nothing in his hand.
14 As he came naked from the womb of his mother,
(Naked) he shall return to go as he came
And nothing shall be left of his labor,
That he may go (with it) in his hand
15 And this indeed is an evil sickness (sore evil),
That as he came so shall he go .
And what his advantage in what he labors for the wind?
16 And all his days are in darkness
And in grief and much rage
And in sickness and vexation

TYRIAN.

17 Behold what I have seen good :
It is good to eat and drink,
And to see good in all one's labor
Wherein one may labor under the sun
The number of the days of his life
Which God hath given him : for this is his portion.

18 And indeed every man to whom God gives wealth and possessions
And has permitted him to eat of it
And to take his portion and to rejoice in his labor
This is the gift of God
19 For he shall not remember the days of his life
For God shall scatter him in the joy of his heart

SOLOMON

6 There is an evil which I have seen under the sun
And it is great among men
2 A man to whom God shall give wealth possessions and honor
And there lacks nothing which his soul may desire
And God permitteth him not to eat of it
But a stranger eats it
This is perplexity and an evil disease

EGYPTIAN

3 If a man shall beget a hundred (children)
And shall live many years
And the days of his years be abundant,
Yet his soul shall not be filled with good,
And even he had no burial—
The untimely born is better than he
4 For into perplexity it came
And into darkness it goes
And in darkness its name shall be hidden
5 For indeed it saw not the sun
And he knew not rest
(The advantage is) to this over that,
6 Though he lived the courses of a thousand years
And knew not good—
Do not all go to one place?

SOLOMON

7 All the labor of man is for his mouth
And yet his soul shall not be satisfied
8 Because there is advantage to the wise man over the fool,
Therefore the poor man knows how to walk in presence of life
9 Better is the sight of the eyes than the longing in the soul
This also is perplexity, and grasping of wind

ASSYRIAN

10 If anything has already been its name has been called
And it is known what is man,
And he shall not be able to contend with the Stronger than he
11 For there are many words which multiply perplexity

7 What is the advantage to man ?
For who knows what is good for man in life
The number of his days of his perplexity ?
For He hath made them in a shadow
For who shall announce to a man
What shall be after him under the sun ?

EGYPTIAN

2 A good name is better than good ointment
And the day of death than the day of birth
3 It is better to go to the house of mourning than to the house of feasting
For this is the end of every man
And the living shall give good to his heart
4 Anger is better than laughter
For in severity of the face the heart shall be made better

SOLOMON.

5 The heart of the wise is in the house of mourning
But the heart of fools is in the house of joy
6 Better to hear the rebuke of the wise
Than to listen to the song of fools
7 Like the crackling of thorns under the pot
So is the laughter of fools

TYRIAN

This also indeed is perplexity
8 That oppression carries away a wise man
And destroys the heart of his nobleness
9 Better is the end of strife than the beginning of it
Better the patient than the proud in spirit
10 Haste not in thy spirit to be angry
For rage dwells in the bosom of fools
11 Say not of what was that former days were better than these
For not in wisdom hast thou inquired about this

SOLOMON

12 Wisdom is better than an inheritance
Yea an advantage to those seeing the sun
13 For in its shelter wisdom is as the shelter of silver
And abundance of knowledge of wisdom shall make one alive through it

ASSYRIAN.

14 Consider the works of God
Who can adorn him whom God has overturned ?

15 In the day of good live in the good
And consider in the day of evil
Consider indeed God has made this harmoniously with that concerning talk
That man should find nothing beyond him

TYRIAN

16 I have seen all these things in my perplexity
There is a righteous man destroyed in his righteousness
And there is a wicked man remaining in his wickedness
17 Be not righteous over much
Nor be excessively wise—
Lest thou perish
18 Be not wicked over much
And become not hardened –
Lest thou die before thy time
19 It is good to restrain thyself in this
And indeed not to soil thy hand with that—
All things shall come to those who fear God

SOLOMON

20 Wisdom shall help a wise man
More than ten powerful ones in a city

TYRIAN

21 For there is no just man in the earth
Who shall do right and not sin
22 And indeed lay not to heart all words spoken by the wicked
That thou hear not thy slave curse thee
For very often it would do thee harm
And afflict in many ways thy heart
23 Because so also thou hast cursed others

SOLOMON

24 All these things have I proved in wisdom
I said I will become wise
25 But she (wisdom) was far from me
Beyond where she had been—
A depth of depth—who shall find it?
26 I turned about I and my heart,
To know and to seek and to search out
Wisdom and a sure calculation
And to know the folly and hardness
And madness of the impious
27 And I find it and declare it more bitter than death
Even as the woman who is a snare,
Her heart is a net,

Bonds are in her hands
The good man before the Face of God
Shall be snatched away from her
And the one sinning shall be taken with
28 Behold this did I find, said the Ecclesiast,
One by one to find a disputing ,
29 Which my soul sought, and I found not—
And I found one man among a thousand,*
And a woman in all these I found not.
30 But behold this I found—
What God has done with man is right
But they have sought many disputings

EGYPTIAN, ASSYRIAN, TYRIAN

Who knows the wise
And who knows the solution of the thing?

SOLOMON

8 Wisdom enlightens a man's countenance
And the shameless in his face shall be hated
2 Watch the mouth of the King,
And haste not concerning the word of the oath of God.
3 Go from His Presence,
Stand not in wicked word
For He shall do whatever He pleaseth,
4 As a King having authority ·
And who shall say, What doest thou?
5 He that keeps the commandment
Shall not know an evil thing ,
And the heart of the wise
Knoweth the season of judgment
6 For to everything is a season, and a judgment ·
So that the knowledge of a man is great to him.
7 For there is none who knoweth what shall be ;
For how it shall be, who shall announce to him?
8 There is no one that hath power over the spirit,
That he may retain the spirit .
And there is no power in the day of death,
And there is no discharge in the day of (that) war
And impiety shall not save that belonging to it.

TYRIAN.

9 This all have I seen :
And I applied my heart to every work,
Which is done under the sun :
In how many things man has authority over man to afflict him.

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* See Proverbs viii and ix.

10 Then I saw the impious borne to the graves,
And from the good they went away
And they praised them in the city
Because they had done thus

SOLOMON

This also is perplexity,
11 That sentence against doers of evil is not swift
Therefore the heart of sons of men is abundantly filled to do evil
12 Whoever has sinned has done evil
From that time is also away from their greatness
For this I know
That it is good to those who fear God
That they may fear before His Face
13 And there shall be no good to the impious
And he shall not prolong his days in shade
Who feareth not before the Face of God

ASSYRIAN

14 There is a perplexity wrought upon the earth,
That there are righteous,
To whom it happens as to the deed of the impious
And there are wicked
To whom it happens as (to) the deed of the just
I have said that this indeed is perplexity
15 And I praised mirthfulness
For there is nothing good for a man under the sun
But that he should eat and drink and rejoice
And this shall be his advantage
In his labor all the days of his life,
Which God has given him under the sun
16 In which I gave my heart to know wisdom,
And to behold the struggle made upon the earth
For both day and night
There is no one seeing sleep with his eyes
17 And I beheld all the work of God,
That a man shall not be able to find out thoroughly
All the work done under the sun
Though a man should labor to seek,
Yet shall he not find out
However a wise man may say he knows it,
He shall not be able to find it
For to all this I gave my heart
And my heart hath known all this
9 As well the righteous and the wise,
As their works, are in the hand of God
And so also love and hate

There is no man hath known all things before their face :
Perplexity in them all
2 There is one ending to the righteous and impious,
To the good and to the wicked
To the clean and the unclean,
To the sacrificer, and to him that sacrificeth not
As is the good, so is the sinner
As the swearer, so the one fearing an oath

SOLOMON

3 This were an evil in all done under the sun
That there were one end to all.
And indeed the heart of the sons of men has been filled with evil
And madness is in their hearts during their life,
And after them among the dead
4 For who is He that gives to all the living?

TYRIAN

There is hope for the living dog .
He is better than the dead lion.
5 For the living know that they shall die,
But the dead know not anything
And there is no longer for them a hire,
For their memory has been blotted out.
6 And even their love and their hate,
And their desire has perished.
And there is no portion still forever
In all done under the sun.
7 Go eat in mirth thy bread .
Drink in good heart thy wine
God is well pleased with thy doings ·
8 Be clothed at every season in white garments,
And stint not oil on thy head
9 And see life with the wife whom thou lovest,
All the days of the life of thy perplexity,
Which has been given thee under the sun ,
For this is thy portion in thy life,
And in the labor thou laborest under the sun (')
10 Whatsoever thy hand findeth to do
Do it with thy might
For there is no deed nor reasoning
Nor knowledge nor wisdom
In Hades, whither thou goest (!)

SOLOMON.

11 I returned : and saw under the sun
That not to the swift is the race,

Not to the mighty the battle,
Not to the wise man bread,
Not to the prudent wealth,
Not to the knowing favor
For season and chance happen to them all
12 For indeed a man has not known his season
Like the fishes taken in an evil net
And like birds captured in a snare
So are snared the sons of men in an evil season
When it falls upon them suddenly

ASSYRIAN

13 And indeed I saw this wisdom under the sun
And it is great to me
14 If a city be small and the men in it few
And a great king come against it
And besiege it and build great bulwarks against it
15 And there be found in it a poor wise man,
And he save the city by his wisdom
No man remembered the poverty of that man
16 And I said, Wisdom is greater than power
And yet the wisdom of the poor man is scouted,
His words are not listened to

• SOLOMON

17 The words of the wise are heard in refreshment
More than the shoutings of rulers among fools
18 Wisdom is better than weapons of war
And one sinner will destroy much good
10 (So) dead flies corrupt the preparation of oil of fragrance
Better a little honor for wisdom
Than great glory for folly

EGYPTIAN

2 The heart of the wise is at his right
But the heart of the fool at his left
3 Indeed, whenever the fool goeth in the way
His heart faileth him
Whatever he thinks it is folly
4 If the spirit of the ruler rise against thee
Leave not thy place
For forbearance heals great sins

TYRIAN

5 There is an evil which I have seen under the sun:
As something not intended it proceeded from the face of the ruler
6 A fool was presented with great exaltations
And the wealthy shall sit with the humble.

7 I saw slaves upon horses,
And rulers walking as slaves on the earth

ASSYRIAN

8 The digger of a ditch shall fall into it
And a serpent shall bite the destroyer of a hedge

EGYPTIAN

9 The remover of stones shall be hurt by them .
The splitter of wood shall be endangered by it

TYRIAN

10 If the axe fall, he has disturbed its face,
And he must labor labors :
That man's wisdom is not excessive
11 If a serpent bite through not having been charmed,
There is no advantage to the charmer.

SOLOMON

12 The words of the mouth of the wise are grace
But the lips of the fool shall drown him
13 The beginning of the words of his mouth is folly,
And the last of his mouth is wicked madness :
14 And the fool multiplies words.

ASSYRIAN.

Man knoweth not what hath been
Nor what shall be
For (that which comes) after who shall tell him ?
15 The labor of fools afflicts them .
He knoweth not how to go to the city.

TYRIAN.

16 Woe to thee, city,
Whose king is young,
And whose rulers eat in the morning !
17 Happy thou, O land,
Whose king is son of the free,
Whose rulers eat in season,
For strength, and shall not be ashamed !
18 Through sloth the roof will be abased,
And in idleness of hands the house will leak.
19 For laughter do they prepare bread and wine,
And oil to make glad the living :
And to the expenditure of silver
Shall all things be obedient.

EGYPTIAN

20 And indeed curse not the King in thy thought,
In thy bedchamber curse not the rich
For a bird of the air shall carry thy voice
And that which has wings shall tell thy speech
11 Cast thy bread upon the face of the waters
For in fullness of days thou shalt find it
2 Give a portion to seven aye to eight
For thou knowest not what evil shall be on the earth

ASSYRIAN

3 If the clouds be full of rain
They empty themselves on the earth
Whether the tree falls to the South
Or whether it falls to the North
In the place where the tree falls
There it shall be
4 The one watching the wind sows not
The one gazing at the clouds shall not reap
5 In which there is none who knows the way of the spirit

SOLOMON

As the bones (grow) in the womb of a woman with child
So thou knowest not the works of God,
All the things that He doeth
6 In the morning sow thy seed,
And in the evening hold not thy hand
For thou knowest not which shall flourish
Whether this or that
Or whether both shall be alike good
7 Sweet is the light
And good to the eyes to behold the sun
8 For if a man should live many years,
Let him rejoice in them all
Yet let him remember the days of darkness,
For they shall be many
All that cometh is perplexity
9 Rejoice, oh young man in thy youth
And let thy heart cheer thee in the days of thy youth
And walk blameless
In the ways of thy heart
And not in the sight of thine eyes
And know that in all these things
God will bring thee into judgment
Therefore put away wrath from thy heart,
10 And remove wickedness from thy flesh
For youth and thoughtlessness are perplexity

12 And remember thy Creator
In the days of thy youth
Before the evil days come
And the years touch, when thou shalt say
I have no pleasure in them
2 Before the sun and the light be darkened,
And the moon and the stars ,
And the clouds return after the rain
3 In the day when the keepers of the house tremble,
And the men of might are turned aside,
And the grinders cease because they are few,
And those looking out of the windows shall be darkened,
4 And they shall close the doors in the street,
In weakness of voice of the grinder ,
And he shall rise at the voice of the ostrich,
And all the daughters of song shall be abased.
5 And they shall look to the height,
And terrors be in the way .
And the almond shall blossom,
And the grasshopper be heavy,
And the caper berry be scattered
Because a man has gone to the house of his eternity,
And the mourners have gone about the streets
6 Or ever the silver cord be untwisted
Or the golden bowl broken
Or the pitcher be broken at the spring
Or the wheel overturned at the cistern :
7 Or the dust returned to the earth as it was,
And the spirit returned to God who gave it.

SUMMING UP BY THE PRESIDING OFFICER.

8 Perplexity of perplexities, as said the Ecclesiast,
All is perplexity.

9 And moreover because the Ecclesiast was wise,
Because he thoroughly taught man knowledge,
And the ear shall trace out the adornment of parables,
10 The Ecclesiast sought many things
To find acceptable words,
And the writing of correctness,
Words of truth.

11 The words of the wise are as goads,
And as spikes well planted :
They of the assemblies
Gave them from one shepherd.

12 And moreover by them my son, be warned
Of making many books there is no end
And much anxious thought
Is a weariness of the flesh

The end of the discourse, the whole, listen to.
13 Fear God
And keep His commandments
For that is the whole (of) man
14 For God will bring every deed into judgment:
With every hidden thing,
Whether it be good
Or whether it be evil

The Atomic Mass of Tungsten

By Mary E Pennington and Edgar F Smith

(Read before the American Philosophical Society, November 2, 1894.)

A study of the literature relating to this subject discloses the fact that while, in most instances, every effort was made to eliminate foreign matter from the material employed in the numerous investigations which have been conducted at various times, several doubtful points continue The object of this communication is to direct attention to one of these possible sources of error, viz., the presence of traces of molybdenum, and to present results obtained after its evident removal.

The earlier investigations relating to the atomic mass of tungsten are rather numerous, but of these that of Schneider is without doubt deserving of the most confidence, chiefly for the pains taken in preparing pure material for the later experiments The author offers satisfactory evidence of the absence of possible contaminating substances, and in writing of the presence of molybdenum employs these words: "Molybdän endlich nicht, weil die Molybdänsäure in heftiger Glühhitze flüchtig ist" (*Journ. prakt. Chemie, 50*, p. 158). The experience of chemists generally is that a complete separation of tungsten trioxide from molybdenum trioxide cannot be attained in this way Indeed, an examination of the experiments recorded by Schneider discloses the fact that he, while engaged in reducing strongly ignited tungsten trioxide, several times discovered on the anterior portion of the reduction or combustion tube "ein weissliches Sublimat." This sublimate Schneider attributes to tungsten chloride, but the question may well be asked, Was it not molybdic acid?

Waddell has made the most recent contribution to our knowledge upon the atomic mass of tungsten (*Amer. Chem. Journ.*, *8*, 280). He experienced much difficulty in obtaining pure tungsten trioxide. He found by considerable investigation that Rose's method for the separation of molybdenum and tungsten was the most convenient. Traube (*Jahr. fur Mineralogie*, etc., Beilageband 7, 232) and more recently Friedheim (*Z. fur anorg. Chemie*, *1*, 76) has shown that this procedure does not entirely eliminate the molybdenum. Recent investigations, in this as well as in other laboratories, upon artificial and supposedly pure, as well as natural tungstates have proved that these all contain molybdenum in appreciable amounts, and it may well be questioned whether the earlier determinations of the atomic mass of tungsten were not affected by the presence of traces of molybdenum. Its complete and absolute removal would tend to raise the value of this constant of tungsten. An effort to this end appeared to be desirable.

An attempt was first made to free the trioxide from impurities through the sodium salts. This course was abandoned inasmuch as traces of alkali persistently adhered to the tungsten. This fact is not new, Schneider was fully aware of it, and in consequence he had recourse to another method which was also adopted in this investigation with some modifications.

A quantity of tungsten trioxide, derived from wolframite, was heated in a porcelain dish for three days with concentrated nitric acid. The latter was then decanted and the yellow oxide was well washed with water. It was next subjected to the action of boiling *aqua regia* for the same length of time, the acid solution, however, being removed from time to time. The washings and acid liquor were tested for iron. When this was no longer detected the washed trioxide was dissolved in yellow ammonium sulphide, air being excluded as much as possible. The solution was filtered from insoluble material, and concentrated almost to the point of crystallization, when hydrochloric acid was added. The liquid was removed from the resulting precipitate, which was ignited, then boiled with nitric acid, and later with *aqua regia*. The resulting trioxide no longer showed the presence of iron and manganese. It was then washed, brought into a porcelain dish, covered with distilled water and ammonia gas conducted over the liquid until it was saturated. Several days were required for this purpose. Only a very small residue remained undissolved. It contained a trace of silica and a little greenish yellow oxide. Hydrogen sulphide gas was next introduced into the ammoniacal solution, which was then digested at 80° C., for several hours. On the addition of pure dilute hydrochloric acid to this solution tungsten trisulphide was precipitated. This was filtered out, washed and roasted in a large porcelain crucible with air access. The trioxide prepared in this manner no longer contained silica, iron or manganese. If tin had been originally present it would have gone out with the *aqua regia*, and any columbic acid would have remained when the trioxide was subjected to the ammonium sulphide treatment. The next step was to prove the presence or absence of molybdenum. A portion of the purified tungsten trioxide was converted into the ammonium salt and the sulphocyanide test

(Braun *Zeit f Analyt Chemie* 2 36) for molybdenum applied to its aqueous solution The presence of molybdenum was very evident The ignition of the tungsten trioxide in the earlier stages of purification had not eliminated this constituent Instead of adopting Rose s method as was done by Waddell and thus introducing the possible contamination from a fixed alkali recourse was had to the reaction of Debray—the volatilization of the molybdic acid as oxychloride—MoO_3 2HCl (*Compt rend* *46* 1098 and Liebig s *Annalen* *108* 250) The experiments of Pechard (*Compt rend* *114* 173 and *Zeit f anorg Chemie* *1* 262) as well as those more recently made by Smith and Oberholtzer (*Journ Am Chem Soc* *15* 18 and *Zeit f anorg Chemie* *4* 236) and by Smith and Maas (*Journ Am Soc* *15* 397 and *Zeit f anorg Chemie* *5* 280) give evidence that by this means molybdenum can be expelled from tungsten derivatives To this end the remainder of the tungsten trioxide was placed in portions in a porcelain boat and exposed to the action of hydrochloric acid gas aided by a gentle heat (150–200° C) until a volatile sublimate of MoO_3 2HCl was no longer noticed Upon reoxidizing the residual tungsten trioxide in open porcelain crucibles and then subjecting portions of the same to the sulphocyanide test the presence of molybdic acid was no longer observed This was taken as an evidence of its complete removal

The trioxide subjected to the treatment described in the last paragraph was suspended in water into which ammonia gas was conducted The oxide dissolved without leaving a trace of foreign matter The salt obtained upon evaporation was crystallized three times it was then dried and ignited with careful exclusion of dust This material was now regarded as sufficiently pure for the experiments projected As it was not intended to attempt any determinations by reduction of the oxide the latter was reduced in a current of hydrogen carefully purified to the metallic state The reductions were made in a large platinum crucible after the manner of Von Pfordten (*Ber d deutsch Chem Gesell* *17* 781) Inasmuch as the reduced metal slowly alloys with the platinum the resulting metallic powder was in all instances gently shaken from the crucible after it had cooled in a current of hydrogen The reduction of trioxide proceeds quite rapidly in the above manner and is always complete The product is dark gray in color Its specific gravity was found to be 18 64 at 0° It was carefully preserved from dust and moisture in drying bottles

The amount of oxygen absorbed by the conversion of tungsten into its trioxide was made the basis of the determinations recorded in this paper

The oxidations were made in porcelain crucibles These were supported in close fitting asbestos rings so that reducing gases could not gain access to the hot oxide To avoid loss from particles being carried out mechanically a porcelain lid wider than the crucible was placed over it at the height of one half inch A careful examination of this lid from time to time showed no traces of tungstic oxide Dust particles were also excluded in this manner No other work was done in the room in which these oxidations were performed All draughts were avoided The crucibles were handled with nickel crucible tongs They were allowed to cool in vacuum desiccators over sulphuric acid Calcium chloride cannot apparently be used for this purpose at least a superficial greenish tinge was always noticed on the oxide cooled in this way Direct sunlight also causes a reduction of the trioxide therefore the desiccators were kept covered with a black cloth

At the beginning of each oxidation the flame applied was quite small The metal increased in bulk as it oxidized and in five minutes had assumed a light yellowish green color At the expiration of half an hour the heat was increased Later a stronger heat was allowed to act and continued until the oxidation was finished The first period of each oxidation continued through five hours The crucible and contents were cooled and weighed The second period lasted three hours additional after which the crucible was allowed to cool It was again weighed and even if there was no change in weight from that first recorded the ignition was continued for two hours more The third weight if constant was taken as final Each oxidation therefore was not considered finished until it had been continued through a period of at least ten hours

The weighings were made upon a Becker balance with weights which had been adjusted for this work The vacuum standard was observed and oxygen taken equal to sixteen in all the calculations The results were as follows

	WEIGHT OF TUNGSTEN IN GRAMS	WEIGHT OF OXYGEN IN GRAMS	ATOMIC MASS OF W
1	—0 862871	—0 223952	—184 942
2	—0 650700	—0 168900	—184 923
3	—0 597654	—0 155143	—184 909
4	—0 666820	—0 173108	—184 903
5	—0 428228	—0 111168	—184 900
6	—0 671920	—0 174406	—184 925
7	—0 590220	—0 153193	—184 933
8	—0 568654	—0 147588	—184 943
9	—1 080978	—0 280600	—184 913
	Mean		184 921

Maximum	184 943
Minimum	184 900
	043

Clarke (*Recalculation of the Atomic Weights* 1882 Washington) and Becker (*Atomic Weight Determinations* 1880 Washington) in their recalculations of this constant of tungsten both arrive at the figures 184 02

($O=16$), while Ostwald (*Outlines of General Chemistry*, translated by Walker, 1890, p. 80) says, "the mean of the good determinations is $W=184$." Waddell (*Amer. Chem. Jr.*, *8*, 280) gives as the mean of his determinations 184.5 ($O=16$). The results presented in this communication show, therefore, a wide difference from those usually looked upon as most correct.

The evidence in earlier papers of the absence of molybdenum from the tungsten is far from satisfactory. Waddell recognizes this, hence he employs Rose's method for the removal of molybdenum from his starting-out material. Since the publication of his research other experimenters have declared and proved the insufficiency of this method (Traube, Friedheim, *loc. cit.*) for the purpose to which Waddell applied it. For this reason the Rose method was not followed in this present investigation, as well as from fear that it might introduce alkali, difficult to eliminate. As a substitute for it the method of Debray was adopted.

In considering the factors that possibly could have caused a rise in the atomic value other than that occasioned by the complete removal of molybdenum, two suggest themselves. First, the occlusion of hydrogen by the finely divided metallic tungsten, upon cooling in that gas, would produce such a result. Waddell (*loc. cit.*) by one experiment is satisfied that such gas occlusion does not occur. Derenbach (*Inaug. Dissertation*, Würzburg, 1893) claims that there is an appreciable retention of hydrogen by the finely divided metal. The question is therefore one of importance, and while this communication contains no data on this point, yet if an occlusion equal to that claimed by Derenbach (*Dissertation*, p. 43) be granted to have occurred in each experiment recorded in this investigation the final result would not be equal to that actually obtained. We must therefore look further for the cause of the rise in the atomic value. The reductions of the trioxide were made in a platinum vessel. An examination of the metallic tungsten for platinum did not show its presence.

Again, tungsten trioxide volatilizes slightly at elevated temperatures; its escape would operate to augment the final value of the tungsten constant. There is, however, no evidence that loss in this way did occur, for the porcelain lid suspended over the crucible during the long ignition period never showed the presence of trioxide. Even if such a volatilization had taken place, it is not at all probable that three weighings could have been made with no change in the same. Furthermore, the remarkable concordance of the individual results among themselves precludes the idea that the rise in the found atomic mass is attributable to volatilization of trioxide. In the end it seems most reasonable to assume that the new value is due to a full and complete elimination of the last traces of molybdenum from the tungsten prior to its oxidation.

Chemical Laboratory, University of Pennsylvania,
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The Atomic Mass of Tungsten

By Edgar F Smith and Ed. D Desi.

(Read before the American Philosophical Society, November 2, 1894)

Most of the experiments made to determine this constant consist in reduction of the trioxide and the subsequent oxidation of the metal. Two experimenters have attempted to weigh the water produced in the reduction of the trioxide A. Riche (*Annal de Chim et de Phys*, (3) *50*, 10, 1857) made five such trials The atomic mass of tungsten, deduced from his experiments, equals 174 (O=16) Three years later Bernoulli (*Pogg. Ann*, iii, 599) made two experiments and his recorded value for the constant is 186+ In both instances there is considerable variation in the individual results

In a previous paper by Pennington and Smith a value (184.9) was obtained that differs quite appreciably from that usually accepted as representing the true atomic mass of the element under discussion. We have undertaken in this present investigation to determine the atomic value from the quantity of water formed in the reduction of the trioxide chiefly for the purpose of ascertaining whether the elimination of the last traces of molybdenum would likely produce the great rise in atomic mass It will be remembered that great stress was laid upon this point by Pennington and Smith In the preparation, therefore, of our trioxide we adhered closely to their method of purification and observed all precautions laid down by them For details, therefore, we would refer the reader to their paper

The hydrogen used by us in the reductions was prepared from sulphuric acid and the purest zinc obtainable To purify the gas it was conducted through a series of bottles containing potassium permanganate, an alkaline lead nitrate solution, silver nitrate, caustic potash, sulphuric acid, calcium chloride, and finally through a glass tube nine inches long, filled with bright, polished iron wire. The latter was heated constantly with a Bunsen burner. After this the gas was admitted to the tube where it came in contact with the ignited trioxide, contained in a platinum boat. The water produced in the reduction was collected in a weighed, glass-stoppered U-tube, filled with anhydrous calcium chloride. A similar tube was attached to this to prevent absorption of moisture from the surrounding atmosphere.

All weighings were reduced to the vacuum standard, and in the calculations oxygen was taken as *16* and hydrogen as 1.008 (Clarke).

Results

WO_3	H_2O	AT MASS W
0 983024	0 22884	184 683
0 908424	0 28189	184 709
1 008074	0 23409	184 749
0 911074	0 21184	184 678
0 997974	0 23179	184 704
1 007034	0 23389	184 706
Mean		184 704

Maximum	184 749
Minimum	184 678
Diff	071

The mean *184 704* falls below that given by Pennington and Smith The discrepancy may possibly be due to the method or the personal factor entering into the work may account for it However the result we believe clearly proves that the atomic mass of tungsten is certainly greater than what is generally assumed as correct and in all likelihood the molybdenum contained in the tungsten has caused the low values found by previous experimenters *

CHEMICAL LABORATORY UNIVERSITY OF PENNSYLVANIA
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Notices of Presumably Undescribed Infusoria

By Dr Alfred C Stokes

(Read before the American Philosophical Society November 2 1894)

Salpingœca globosa sp nov (Fig 1) —Lorica pedicellate carafe shaped the body subspherical tapering at the posterior extremity to the pedicle neck conspicuous about one third as long as the body of the lorica the margin flaring pedicle often oblique somewhat flexuous and about as long as the entire lorica Solitary Length $\frac{1}{1250}$ inch *Hab* —Fresh water near Trenton N J attached to filamentous algæ

Salpingœca collaris sp nov (Fig 2) —Lorica vasiform less than four times as long as broad but divisible by its characteristic contour into two regions, a posterior inflated obovate portion tapering to the pedicle and an anterior region subcylindrical somewhat exceeding the posterior region in length its lateral margins parallel the anterior aperture circular its borders everted , pedicle usually exceeding the lorica in length enclosed animalcule freely motile within the lorica, at times situated exclusively within the frontal neck like portion, at others extending into the anterior region of the posterior part of the sheath , when disturbed retreating into the posterior region and advancing to the frontal portion when its fright has passed, the sarcode then completely filling that part of the lorica and taking its shape Length of lorica $\frac{1}{1200}$ inch *Hab* —Standing water from the Morris and Essex canal New Jersey

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* A review of all the methods heretofore used in determining the atomic mass of tungsten has been begun by one of my assistants Care is being taken to completely eliminate certain sources of error which have not been absolutely excluded in earlier work —E F S

The water in which this beautiful and characteristic form was found was taken from the canal late in the autumn of 1891 by Mr S Helm of New York city, and by him sent to me It remained on my table until February 17, 1892 almost unnoticed except that a little water was occasionally added to supply that lost by evaporation On the date last mentioned the animalcule was found in some abundance, attached to various submerged fragments and in company with a profusion of *Salpingœca gracilis* J Clk a form which it somewhat resembles, and near to which it should be classified

Prorocentrum hamatum sp nov (Fig 8) —Body ovate less than twice as long as broad smooth, depressed the lateral borders slightly flattened, the posterior margin evenly rounded and obtusely pointed dorsal surface convex ventral aspect somewhat flattened, bearing on its frontal margin a stout anteriorly projecting, obtusely pointed, often colorless process which is bent hook like almost at a right angle, directed towards the left hand side and slightly excavated dorsally thus exhibiting a ledge like or shelf like projection towards that aspect of the body frontal border truncate, surrounded within the margin by an annular groove, the right hand and left-hand ventral continuations of which extend obliquely along the adherent posterior prolongation of the frontal process and unite to form a subcentral, longitudinal ventral depression , anterior flagellum spirally undulating, taking its origin from within the ventral portion of the anterior groove, on the left hand side of the posterior prolongation of the hook like process, and extending round the frontal border into the groove on the right hand side of the frontal projection , ventral flagellum long trailing vibratile taking its origin from near the central region of the ventral groove , nucleus subspherical, located near the posterior extremity, often with an apparently amylaceous corpuscle on one side and near it Chromatophores linear, elongate, vermicular or variously curved. Length, $\frac{1}{500}$ inch *Hab* —Brackish water from a salt marsh on Coney Island, N Y Movements rotary on the longitudinal axis Abundant

This form was collected and sent to me by Mr H. C Wells, of Short Hills, N J.

Although *Trachelomonas* is probably not an infusorian, the following descriptions are here included for convenience

Trachelomonas fusiformis, sp nov. (Fig 4) —Lorica fusiform, three times as long as broad, punctate with minute, scattered, conical elevations which are larger and more conspicuous near the margin of the posterior prolongation , anterior region narrowed, neck-like, the frontal border slightly everted, the margin minutely denticulate ; color brown. Length of lorica, $\frac{1}{375}$ inch *Hab* —Pond water, near Trenton, N J ; movements tremulous and rotary on the longitudinal axis

Trachelomonas sphærica, sp nov (Fig 5) —Lorica subspherical, somewhat depressed, the anterior aperture produced into a short, cylindrical, neck-like region, its frontal margin with four or more obtuse denticulations , entire surface of the lorica armed by long, conspicuous, obtuse spinous processes, the largest of which are subequal in length to the length of the neck-like portion of the sheath , color reddish brown , flagellum in length equaling or exceeding the circumference of the lorica. Diameter, including the length of the spinous processes, $\frac{1}{300}$ inch. *Hab.*--Pond water, with *Lemna*, near Trenton, N J Movements rapidly rotary

Trachelomonas acanthophora, sp. nov (Fig 6).—Lorica fusiform, about twice as long as broad, the posterior region somewhat suddenly contracted into a short, naked, punctate or smooth, prolongation, terminated by three diverging spines ; anterior region produced as a neck-like portion, naked and punctate or smooth, the anterior border truncate, the margin bearing four or more radiating spines ; central or body region armed by numerous, conical, spine-like prolongations ; flagellum equaling or exceeding the lorica in length ; endoplasm green. Length of lorica, including spines, $\frac{1}{500}$ inch ; width without spines, about $\frac{1}{1500}$ inch. *Hab.* —Pond water, with *Lemna*, near Trenton, N J. Movements rotary on the longitudinal axis.

Vaginicola longipes, sp. nov. (Figs. 7, 8) —Lorica trumpet-shaped, much compressed, rather more than four times as long as broad, widest and inflated near the middle third, thence tapering posteriorly to a narrow, irregularly subcylindrical region forming from one-third to one-half of the entire length of the lorica ; anterior border slightly everted, the lateral margin somewhat constricted beneath the frontal region , lorica often irregularly constricted, the posterior, pedicle-like portion frequently curved, and variously contorted, bent or irregularly inflated, the whole becoming chestnut-brown with age ; enclosed animalcule adherent posteriorly to a long, narrow pedicle apparently attached to the posterior extremity of the lorica, but often there becoming indistinct, and at times seemingly adherent to one lateral margin ; body soft and flexible, finely striate transversely, extending slowly and irregularly, often undulate or vermicular in form, the contracted anterior region bending posteriorly, the flexure thus produced advancing towards the anterior aperture of the lorica, the unexpanded peristomal region apparently wedged against the lateral borders of the sheath, the animalcule thus remaining until another contraction changes its position extended body elongate very narrow projecting for from one third to one half its length or more beyond the frontal aperture peristome broad somewhat oblique, contracted body obovate nucleus elongate narrow band like exceedingly tortuous during the contracted state of the animalcule contractile vesicle single, spherical anteriorly situated Length of lorica about $\frac{1}{90}$ inch *Hab* — Attached to aquatic plants from Rancocas creek at New Lisbon N J

Caulicola (*caulis* stem *colo* to inhabit) gen nov — Animalcules loricate as in *Thuricola* except that the lorica is conspicuously pedicellate and possesses a valve like appendage which is not attached to the wall within the lorica as in *Thuricola* but to the lateral margin of the anterior aperture

Caulicola valvata sp nov (Fig 9) Lorica ovate less than twice as long as wide posterior border rounded somewhat inflated thickened centrally and with a short posterior projection at its point of attachment to the pedicle lateral walls often slightly undulate and usually narrowed at the truncate anterior aperture valve like appendage attached to the lateral border of the anterior aperture rising by the pressure of the extending animalcule and when fallen completely closing the orifice by a horizontal flat topped lid pedicle slender, thickened centrally, and with a short anterior projection at its point of attachment to the lorica tapering posteriorly and about one third as long as the lorica, body of enclosed animalcule colorless transparent and when extended, protruding about one fourth of its length beyond the lorica cuticular surface transversely striate nucleus elongate band like Length of lorica $\frac{1}{500}$ inch *Hab* —Brackish water from Coney Island N Y Collected and sent to me by Mr H C Wells of Short Hills N J

Bicosœca phiala sp nov (Fig 10) —Lorica elongate vasiform less than twice as long as broad widest anteriorly tapering posteriorly to the pedicle anterior margin everted truncate lateral borders often almost rectilinear pedicle short enclosed animalcule not exserted contractile vesicles two or more, often four near the posterior extremity, nucleus not observed Length of lorica $\frac{1}{1875}$ inch *Hab* —Pond water from near Trenton N J attached to filamentous objects

Enchelyodon vesiculosus sp nov —Body elongate ovate, one lateral border somewhat concave the other convex, both extremities rounded, the anterior somewhat truncate, soft flexible and changeable in shape, about twice as long as broad the cuticular surface longitudinally striate, entirely ciliate, pharynx obconical, about one third as long as the body, longitudinally plicate, the anterior orifice transversely oval, nucleus apparently subspherical or broadly oval, subcentrally located, contractile vesicles three or more, near the posterior extremity, anal aperture postero terminal, endoplasm enclosing numerous, green corpuscles which obscure the internal structure, and render the body semi opaque Movements rotary on the longitudinal axis Length of body, $\frac{1}{105}$ inch *Hab* —Pond water in early spring, from near Trenton, N J.

This form differs from *E farctus* C & L in the presence of the multiple contractile vesicles and in the single rounded nucleus the latter in *E farctus* being recorded as band shaped

The Infusorian was obtained in abundance in a gathering made in the middle of February in the mild winter of 1889-90 Reproduction is by transverse fission

Nassula trichocystis sp nov (Fig 11) —Body elongate ovate or subelliptical cylindrical more than twice as long as broad the two extremities subequal oral aperture near the anterior extremity in a slight depression or concavity of the lateral body margin and followed by a conspicuous conical pharyngeal rod fascicle extending to near the body centre oral cilia somewhat larger and more conspicuous than those of the general surface contractile vesicle single spherical laterally placed in the posterior part of the anterior body half often leaving small lacunæ at complete systole nucleus subspherical subcentrally located trichocysts exceedingly abundant obliquely and densely set within the cortical layer endoplasm frequently exhibiting a movement of rotation Length $\frac{1}{375}$ inch *Hab* —Pond water near Short Hills N J Movements rotary on the longitudinal axis

This form which is interesting on account of the remarkable abundance of trichocysts enclosed by the cortex was collected by Mr H C Wells of Short Hills N J, and by him sent to me

Urostyla vernalis sp nov (Fig 12) —Body elongate ovate or subelliptical soft and flexible about three times as long as broad both extremities rounded the anterior somewhat curved towards the left hand side and slightly narrowed posterior extremity sometimes evenly convex, frequently obtusely pointed on the right hand side of the median line, dorsal aspect convex its cuticular surface irregularly roughened by clusters of minute rounded elevations arranged in irregularly longitudinal series lateral body margins of the larger Infusorians often flattened and subparallel those of the smaller forms convex upper lip crescentic peristome field obovate the anterior region of the adoral depression proper not including any portion of the frontal border but taking its origin posteriorly to that margin at a distance about equal to one tenth the length of the entire body, and extending on the left hand side of the body somewhat obliquely backward towards the right hand side for about one third the length of the ventral surface its left hand margin bearing a series of large and conspicuous adoral cilia and a row of finer paroral cilia the right hand border supporting an undulating membrane and a series of fine preoral cilia, endoral cilia none, uncinate frontal styles from four to six distally bifid and somewhat irregularly placed near the right hand border of the peristome field, ventral surface clothed by fine, vibratile cilia in six parallel longitudinal lines marginal setæ longest, largest and most conspicuous on the posterior border, where they are slightly interrupted those on the two sides of the median line of the body usually directed towards one another and frequently overlapping, anal styles slender fimbriated, from six to eight in number, arranged in an oblique row and not projecting beyond the body margin; contractile vesicle single, spherical, near the left-hand side of the anterior body half in the dorsal aspect, the cuticular surface of which it elevates at its systole, and through which it seems to discharge its contents; nucleus double, the two nodules ovate, one being in the anterior, the other in the posterior body half near the left-hand body margin, and each bearing a laterally attached nucleolus; anal aperture not observed. Length from [illegible] to [illegible] inch. *Hab.*—Shallow wayside pools in the early spring, near Trenton, N. J. Reproduction by transverse fission. Endoplasm brown.

This form bears a somewhat close resemblance to *Urostyla trichogaster* Stokes, but differs conspicuously in its habitat, *U. trichogaster* being found in infusions of decaying vegetable matters, the present species in the clear, pure waters of the pools of early spring. It also differs in the character of the adoral depression, which does not include a part of the frontal border of the body, in the absence of the endoral cilia, and especially in the fewer frontal styles.

The body is exceedingly soft and flexible, and its motions active. The brown endoplasm is often of a beautiful, transparent golden tint. The favorite food is the algal spores and the other small vegetal objects with which the shallow pools are at this time of the year so well supplied, while the food of *U. trichogaster* is chiefly animal.

Acineta corrugata sp. nov. (Figs. 13, 14, 15).—Lorica ovate or subtriangular, compressed, the length but slightly exceeding the greatest breadth, lateral margins convex, tapering towards the pedicle, and variously crenated or almost smooth and even; general surface bearing numerous irregularly disposed but frequently parallel and centrally converging, linear ridges that vary in number, arrangement and general direction with the age of the lorica, in maturity and in old age the interlinear spaces becoming exceedingly prominent as inflated, rounded and elongated prominences, the lateral borders of the lorica then being conspicuously and irregularly crenate; anterior margin slightly elevated centrally, this elevation extending perpendicularly along the subcentral region of the frontal and of the dorsal aspects of the sheath, this in transverse, subcentral optical section having a rhomboidal outline; the lateral borders truncate and emarginate; anterior border of the lorica closed in except for a narrow slit-like aperture traversing it, and an ovate orifice at each antero-lateral margin for the passage of the fasciculate capitate tentacles; frontal region in surface view, compressed and undulate, or with six oppositely disposed concave depressions; pedicle conspicuous, well-developed, hollow and about one-third as long as the lorica; nucleus apparently broadly ovate and subcentrally located; endoplasm coarsely granular; the enclosed animalcule usually nearly filling the cavity of the sheath. Length including pedicle, [illegible] inch. *Hab.*—Attached to filamentous algæ in the brackish water of a salt marsh, Coney Island, N. Y.

The corneous, transparent lorica is exceedingly thin and delicate, vary ing much in connection with the surface plications or ridge-like elevations. In early youth the raised lines being low, inconspicuous and irregularly disposed; in maturity becoming full, rounded and prominent, separated by deep furrows, as if the wall of the lorica had become distended with liquid, dilatation taking place at expansile regions between the ridge-like markings of the earlier stage; in the mature state the lateral borders are protuberantly crenate.

Acineta flexilis, sp. nov. (Fig. 16).—Lorica irregularly subspherical, tapering posteriorly to the short hollow pedicle; anterior border closed, thin, apparently perpendicularly lamelliform, the margin irregularly undulate; two opposite lateral regions each bearing two anteriorly approximating, posteriorly diverging narrow fissures for the passage of the tentacles, the fissures usually being open only sufficiently for the passage of the tentacles except during the final development and the escape of the embryo, when those on the lateral margins and that on the frontal border are seen to be continuous, the expanding fissures closing after the escape of the embryo; pedicle about one seventh as long as the lorica; tentacles capitate, of two kinds and apparently issuing only from the slit-like lateral fissures, one kind being straight, rigid and not often exceeding twice the length of the lorica, the other form filamentous, flexible, writhing and variously curved and coiled, often extending to more than five times the length of the lorica; body of the animalcule subspherical or obpyriform, not filling the cavity of the lorica and in no way adherent to it; endoplasm granular; nucleus broadly ovate, located near one lateral border; contractile vesicle single, spherical, postero-lateral in the region opposite the nucleus. Length of the lorica including the pedicle $\frac{1}{350}$ inch. *Hab.*—Fresh water from near Trenton, N. J., attached to *Spirogyra*.

Codonosiga florea Stokes (*Journ. Trenton Nat. Hist. Soc.*, January, 1888, Vol. I, No. 3).—This was incorrectly placed in the genus *Codonosiga*; it is a *Monosiga* and should be referred to as *Monosiga florea*.

Halnis furcata Stokes (*Journ. Royal Micros. Soc.*, August, 1889).—This generic name being preoccupied, it may, in this instance, be changed to *Halnopsis*, the single known species then being *Halnopsis furcata*.

EXPLANATION OF THE PLATE.

Fig. 1. Salpingœca globosa, with collar retracted.
" 2. Salpingœca collaris.
" 3. Prorocentrum hamatum. × 720.
" 4. Trachelomonas fusiformis. × 500.
" 5. Trachelomonas sphærica. × 460.
" 6. Trachelomonas acanthophora. × 500.
" 7, 8. Vaginicola longipes. × 200.
" 9. Caulicola valvata. × 400.
" 10. Bicosœca phiala, empty lorica. × 835.

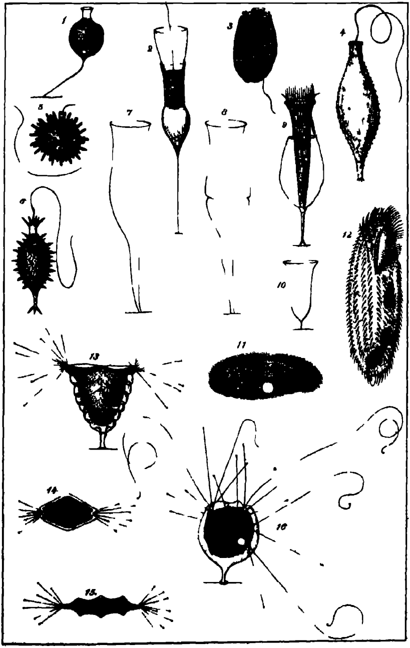
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Fig. 11 Nassula trichocystis × 450
" 12 Urostyla vernalis. × 190
" 13. Acineta corrugata ; mature, but not old, form × 400
" 14 Acineta corrugata , transverse, subcentral, optical section × 400
" 15 Acineta corrugata , surface view of the frontal region , somewhat more enlarged than in Figs 13, 14
" 16. Acineta flexilis × 500

Obituary Notice of John M Maisch.

By Charles S Dolley, M.D

(Read before the American Philosophical Society, December 7, 1894)

The preeminence which American pharmacy has for many years maintained may without doubt be largely attributed to the scientific zeal and ability of the teachers of pharmaceutical science in the various institutions of the country. To no one belongs a greater meed of praise than to the late Prof Maisch, a member of the American Philosophical Society, to which he was elected January 18, 1884.

John Michael Maisch was born of humble parents in Hanau on the Main, Germany, on the 3d of January, 1831 His early education was obtained at the free schools of his native town, and he soon attracted the special attention of his teachers on account of his aptness and diligence. Under one Theobald, he was introduced to the study of mineralogy and microscopy and began practical field work in the vicinity of Hanau, and it was largely due to the interest awakened by this teacher that he became ambitious for a university education and was led to seek instruction outside that afforded him by the curriculum of his school

Under Dr. Bromics he soon demonstrated his fitness for original investigation in chemistry, and was permitted by him to assist in certain studies of the fatty acids and resins.

For a time his inclinations were towards theology, but his increasing interest in natural science led him to abandon the idea and to devote himself with such ardor to his scientific studies as to undermine his strength to such an extent that it became necessary not only to give up close application for a time, but, in the end, to relinquish his strong desire for a university course.

Entering the military service of Hesse, he became impregnated with the revolutionary ideas rife among the soldiery, and recognizing the inconsistency of his position, he resigned his post and, joining the Turners of

Hanau accompanied them in their excursions through the Valley of the Main assisting them in the promulgation of revolutionary sentiments.

In 1849 while engaged in this work he was arrested at Sinsheim and sentenced to four and a half years imprisonment with hard labor but through the connivance of friends he soon after effected his escape and managed to emigrate to America. Landing almost penniless in Baltimore young Maisch took up for a time with factory work but soon managed through his fondness for natural science to make the acquaintance of Drs Wiss and Vogler who aided him in the study of pharmacy and gave him employment for a time during the years 1850 51 in a drug store owned by the former. This store being sold Mr Maisch removed to Washington where he served in a drug store until 185 when his parents and sisters having come to Philadelphia he joined them there. For about two years he acted as drug clerk in Philadelphia and New York and finally entered a chemical factory in Brooklyn. From 1856 to 1859 he was employed by the firm of E B Garrigues and Robert Shoemaker of Philadelphia and in the latter year he accepted an instructor's position in the School of Pharmacy conducted by Prof Parrish in an upper room at the southwest corner of Eighth and Arch streets.

Here his natural love for research his tact and ability as a teacher attracted attention and led to his call to the Professorship of Pharmacy and Materia Medica in the College of Pharmacy of the City of New York, his spare time being employed in the laboratory of Dr E R Squibb. Prof Maisch returned to Philadelphia in 1861, when under Surgeon General Hammond he organized the U S Army Laboratory which during the two and a half years in which he conducted it is said to have effected a saving to the Government of nearly a million of dollars. After the War and until 1871 Prof Maisch carried on a retail drug business at 1607 Ridge avenue but finally gave it up on account of his increasing duties at the Philadelphia College of Pharmacy and as the Secretary of the American Pharmaceutical Association of which he had been from 1856 one of the most active members.

It was in 1866 that John Maisch succeeded William Procter Jr in the Chair of Pharmacy but in the ensuing year he exchanged Chairs with Prof Parrish assuming the title of Professor of Materia Medica and Botany. This position Prof Maisch retained until his death on the 10th of September, 1893. In 1860 he was elected a member of the Board of Trustees of the Philadelphia College of Pharmacy and ten years later accepted the editorship of the *American Journal of Pharmacy*. That John Maisch was a man of unwearied industry, absolute integrity and profound knowledge, is the unanimous testimony of all who were familiar with him and with his teachings and writings, a fact which was emphasized by the conference of the Hanbury Gold Medal upon him by the Pharmaceutical Society of Great Britain for distinguished services and original research in the natural history of drugs. The following is a list of Prof Maisch's contributions to science

1854 On the Adulteration of Drugs and Chemical Preparations. Amer. Journ. Pharm.
Liquor Ferri Iodide. *Ibid.*
1855 On the Incompatibility of Sulphate of Quinia with the Acetates. *Ibid.*
Examination of Bitartrate of Potassa. *Ibid.*
Effects of Sunlight on the Syrup of Iodide of Iron. *Ibid.*
Translation of M. Strecker's Paper on Quinine. *Ibid.*
Contributions to Toxicology. *Ibid.*
1856 On Convenient Modes of Administering Cod Liver Oil. *Ibid.*
On the Relations of Physicians and Pharmaceutists. *Ibid.*
Contributions to Toxicology. *Ibid.*
On an Expeditious Mode of Making Mercurial Ointment. *Ibid.*
On Solution of Gutta Percha. *Ibid.*
On Sulphate of Quinine and Carbonate of Ammonia in Pills. *Ibid.*
On Wine of Colchicum Seed. *Ibid.*
1857 On Protiodide of Mercury. *Ibid.*
On Effervescing Powders. *Ibid.*
Solubility of Iodides in Syrupus Ferri Iodidi. *Ibid.*
On Fluid Extract of Arnica. *Ibid.*
On Fluid Extract of *Uva ursi*. *Ibid.*
On the Detection of a New Falsification of Oil of Bitter Almonds. *Ibid.*
American Eclectic Resinoids. Buchner's Repertorium für Pharmacie. Vol. vi, p. 481.
1858 On the Sale of Poisons in the United States. *Ibid.* Vol. vii, p. 207.
On Fluid Extracts in the United States. *Ibid.* Vol. vii, p. 297.
Remarks on Some Pharmaceutical Preparations. Amer. Journ. Pharm.
On Diluted Acetic Acid. *Ibid.*
On the Preservation of Drugs from Insects. *Ibid.*
Note on Syrup of Hypophosphites. *Ibid.*
On the Decomposition of the Quinia by the Acetates. *Ibid.*
1859 On Extractum Ferri Pomatum. *Ibid.*
On the Preservation of Fluid Extracts. *Ibid.*
On the New System of German Weights. *Ibid.*
On the Proper Menstruum for Fluid Extracts. *Ibid.*
Notes on Fluid Extracts of Buchu, Cimicifuga, Serpentaria and Valerian. *Ibid.*
On the Solubility of Phosphate of Iron. *Ibid.*
On a New Mode of Preparing Some Syrups. *Ibid.*
Manufacturing Pharmacy in the United States. Buchner's Repertorium, Vol. viii, p. 483.
1860 On Examination of Oil of Peppermint. Amer. Journ. Pharm.
On Some Preparations of Calamus Root. *Ibid.*
Gleanings from the German Journals (three articles). *Ibid.*

1860 Alumen Exsiccatum *Ibid*
Analysis of Commercial Glacial Phosphoric Acid *Ibid*
Note on Benzoic Acid and Some Benzoates *Ibid*
On the Detection of Croton Oil in Mixtures *Ibid*
Analysis of Milk *Ibid*
Chemical Notes *Ibid*
Alumen ustum Buchner s Repertorium Vol ix p 127
United States Pharmacy *Ibid* p 145
1861 On *Chelidonium majus* Amer Journ Pharm
On the Adulteration of Carmine *Ibid*
On Commercial Iron by Hydrogen *Ibid*
On the Importation of Mineral Waters *Ibid*
Analysis of the Chalybeate Waters of Sharon Spring New York *Ibid*
On Anacahuite Wood *Ibid*
On the Tincture and Ferrated Tincture of Bark *Ibid*
On the Origin of Bay Rum *Ibid*
On the Volatile Oil of *Myrcia acris* *Ibid*
On the Ferrated Tincture of Cinchona *Ibid*
On the Conversion of Monohydrated into Common Phosphoric Acid *Ibid*
Gleanings from the German Journals (four articles) *Ibid*
Chemical Examination of Cocoa Leaves *Ibid*
On the Mineral Water Trade in the United States Buchner s Repertorium Vol x p 257
On the Medical Flora of the Vicinity of Philadelphia *Ibid* Vol x pp 289 and 359
1862 Gleanings from the German Journals Amer Journ Pharm
On Commercial Belladonna Leaves *Ibid*
Report of Committee on Herbarium *Ibid*
On the Standing of the Pharmacist in the United States Army Buchner s Repertorium Vol xi p 394
On Snake bite Remedies in the United States *Ibid* p 352
1863 On Copaiba Pills Amer Journ Pharm
Gleanings from the German Journals *Ibid*
Note on the Alkaloids of *Menispermum Canadense* *Ibid*
Note on Podophyllum *Ibid*
1864 Practical and Scientific Notes *Ibid*
On Impurities and Adulterations *Ibid*
Gleanings from German Journals *Ibid*
On the Contamination of American Sulphuric Acid with Arsenic *Ibid*
1865 On the Preparation of Heavy Oil of Wine *Ibid*
1866 On the Active Principle of Rhus Toxicodendron *Ibid*
1867 On Liquor Magnesiæ Citratis *Ibid*
On Liquor Ferri Acetatis *Ibid*

1867 On the Specific Gravity of Medicinal Chloroform *Ibid*
On Colchicum *Ibid*
On Tests for the Purity of Glycerin *Ibid*
On Carelessness in the Collection of Drugs *Ibid*
Note on Cheap Glycerin *Ibid*
Gleanings from the German Journals (two articles) *Ibid*
On a Permanent Solution of Pyrophosphates of Soda and Iron *Ibid*
Review of Pharmacopœia Helvetica *Ibid*
1868 Gleanings from the German Journals *Ibid*
On Chloroform *Ibid*
Note to Editor on False Jalap *Ibid*
1869 Gleanings from the German Journals (four articles) *Ibid*
On the Milky Juice of *Lactuca elongata* *Ibid*
On Some Panama Drugs *Ibid*
On the Nomenclature and Definitions of the United States Pharmacopœia *Ibid*
1870 On *Lycopodium clavatum* *Ibid*
On the Weeds of Western Peppermint Plantations *Ibid*
Gleanings (three articles) *Ibid*
On Pharmaceutical Legislation *Ibid*
On Solubility of Glue in Glycerin *Ibid*
1871 Decomposition of Acetate of Morphia in Aqueous Solution *Ibid*
Detection of Turmeric in Powd Rhubarb and Mustard *Ibid*
Ferrated Elixir of Cinchona *Ibid*
Gleanings from Foreign Journals *Ibid*
Gleanings from German Journals (four articles) *Ibid*
Fluid Extract of Chestnut Leaves *Ibid*
Note on Amylo nitrous Ether *Ibid*
Note on Hydrocyanate of Morphia *Ibid*
Note on Some Pill Masses *Ibid*
Precipitation of Quinia by Iodide of Potassium *Ibid*
Seeds of Two Species of Strychnos *Ibid*
Solutions of Alkaloids in Medicated Waters *Ibid*
Syrupus Assafœtidæ *Ibid*
1872 Gleanings from the European Journals (twelve articles) *Ibid*
Loss of the Herbaceous Parts of Plants in Drying *Ibid*
Monobromated Camphor *Ibid*
On an Asserted Specific for Ague *Ibid*
On Some Pectoral Powders of European Pharmacy *Ibid*
On the Botanical Origin of Root of Cypripedium *Ibid*
On the So called African Saffron *Ibid*
Pharmacognostical Notes *Ibid*
Use of Petroleum Benzine in Making Oleoresins *Ibid*
1873 Chloride of Mercurethyl *Ibid*
Impurities Among Rhizomes of Cypripedium *Ibid*
Levico Mineral Water *Ibid*

1873 Gleanings from European Journals *Ibid*
Medicinal Use of Green Soap *Ibid*
Remarks on Elixirs *Ibid*
Selected Formulas from Pharm Germ *Ibid*
Spirit of Nitrous Ether a Supposed Test for Some Alkaloids *Ibid*
1874 Balsams *Liquidamber styraciflua* and *orientale* *Ibid*
Gleanings from European Journals (nine articles) *Ibid*
Notes on Some North American Drugs *Ibid*
Occurrence of Arbutin in Some Ericaceous Plants *Ibid*
Pharmacognostical and Chemical Notes *Ibid*
Remarks on Resin of Podophyllum *Ibid*
1875 Constituents and Properties of Potentilla *Ibid*
Gleanings from European Journals (nine articles) *Ibid*
Medicated Waters *Ibid*
Note on Tinctura Opii Muriatica *Ibid*
On Some Substitutions *Ibid*
Remarks on Cinchoquinine *Ibid*
1876 Asserted Presence of Tannin in Gentian *Ibid*
Fucus vesiculosus and Some Allied Species *Ibid*
Gleanings from Foreign Journals (ten articles) *Ibid*
Notes on the Genus Teucrium *Ibid*
Notes on the International Exposition (three articles) *Ibid*
Notes on the Quinine Flower *Ibid*
Remarks on Cinchoquinine *Ibid*
Remarks on Extract of Jalap *Ibid*
Use of Metrical Weights in Prescriptions *Ibid*
1877 Detection of Castor Oil in Copaiba *Ibid*
Examination of a Cure for Love of Liquor *Ibid*
Formulas and Preparations of New Medicaments *Ibid*
Gleanings from the Foreign Journals (eight articles) *Ibid*
Note on Dialyzed Iron *Ibid*
Note on *Xanthium spinosum* *Ibid*
Note on the Permanent Exhibition *Ibid*
The Metrical System in Prescriptions *Ibid*
The Strength of Tinctura Opii *Ibid*
1878 *Aspidium marginales* *Ibid*
Berberis of the Pacific Coast *Ibid*
Gleanings from Foreign Journals (six articles) *Ibid*
Notes on a Few American Drugs *Ibid*
Useful Species of Viburnum *Ibid*
1879 Artificial Fruit Essences *Ibid*
Poisonous Species of Astragalus *Ibid*
Sulphocarbolate of Potassium *Ibid*
Supposed Alkaloids of Podophyllum *Ibid*
1880 Note on Some American Species of Artemesia *Ibid*
Presence of Tannin in Gentian *Ibid*

1881 Compound Spirit of Cinnamon *Ibid*
Dose of Extract Physostigmatis *Ibid*
Georgia Bark *Ibid*
Manufacture of Quinia in the United States *Ibid*
Oleum Betulæ Empyreumaticum *Ibid*
Gleanings in Materia Medica (four articles) *Ibid*
Origin of False Senega *Ibid*
Orthography of the Metric Units *Ibid*
Poisonous Principle of Anacardium *Ibid*
Practical Notes from Foreign Sources *Ibid*
Stearopten of Buchu Leaves *Ibid*
Tinctura Rusci *Ibid*
Xanthorrhœa Resins *Ibid*
1882 Gleanings in Materia Medica (ten articles) *Ibid*
Practical Notes from Various Sources *Ibid*
Preparation of Mercurial Ointment *Ibid*
Syr Ferri Protochloridi *Ibid*
China and Allied Species of Salvia *Ibid*
Useful American Myrtles *Ibid*
1883 Comparison of Galenical Preparations (six articles) *Ibid*
Galenical Preparations of the German Pharmacopœia (four articles) *Ibid*
Gleanings in Materia Medica (eight articles) *Ibid*
Practical Notes from Various Sources (five articles) *Ibid*
Relative Strength of Certain Preparations *Ibid*
1884 Chemical and Pharmacognostical Notes *Ibid*
Laboratory Notes—Abstracts from Theses (two articles) *Ibid*
Notes on Researches on Capillarity *Ibid*
Practical Notes *Ibid*
1885 Gleanings in Materia Medica (eight articles) *Ibid*
Materia Medica of the Mexican Pharmacopœia (eight articles) *Ibid*
Pharmaceutical Preparations of the Mexican Pharmacopœia (four articles) *Ibid*
Practical Notes (two articles) *Ibid*
Commercial Spanish Saffron *Ibid*
Indigenous Species of Croton *Ibid*
Useful Plants of the Verbenaceæ *Ibid*
1886 Commercial Sulphate of Quinine *Ibid*

Gleanings in Materia Medica (six articles) *Ibid*
Materia Medica of the New Mexican Pharmacopœia (four articles) *Ibid*
Note on Yerba and Raiz del Indio *Ibid*
Practical Notes and Formulas *Ibid*
Strophanthus or Heart Poison *Ibid*

1886 Gotthilf Heinrich Ernest Muhlenberg as a Botanist (An Address before the Pioneer Society of Philadelphia) Hoffman's Pharmaceutische Rundschau New York
1887 Chemical Notes from Theses Amer Journ Pharm
Gleanings in Materia Medica (six articles) *Ibid*
Jalap Resin and Jalapin *Ibid*
Practical Notes from Various Sources *Ibid*
Remarks on Cancer Cure *Ibid*
1888 Blue Coloring Matter in Flowers *Ibid*
Gleanings in Materia Medica *Ibid*
Notes on Some New Remedies *Ibid*
Notes on Some Old Remedies *Ibid*
Practical Notes from Foreign Journals *Ibid*
The Genus Luffa *Ibid*
1889 Preparations of Mustard for Internal Use *Ibid*
Useful Plants of the Genus *Psoralea* *Ibid*
Origin of False Senega Root *Ibid*
Notes on Some Indigenous Remedies *Ibid*
1890 Botanical Origin of Some Pharmacopœial Drugs *Ibid*
Gleanings in Materia Medica *Ibid*
Morphine Salts and Hydrocyanic Acid *Ibid*
Notes on Scopola *Ibid*
Pharmacopœial Assays of Drugs and Galenicals *Ibid*
Plant Groups and Constituents and Properties *Ibid*
Practical Notes from Various Sources *Ibid*
Prospective Camphor Industry of Florida *Ibid*
Some North American Medicinal Plants *Ibid*
1891 Notes on Vegetable Drugs used in Mexico *Ibid*
Notes on Some North American Medicinal Plants *Ibid*
1892 *Polygala alba* *Ibid*
Soda Mint *Ibid*
Vanilla Plant an Epiphyte *Ibid*
1893 On the Tubers of Dioscorea Species *Ibid*

NOTE —The writer desires to acknowledge the kindness of Professors Remington and Trimble of the Philadelphia College of Pharmacy in furnishing him with data and particularly his indebtedness to the biographical sketch by Prof Remington in the *American Journal of Pharmacy*

The Château de Rochambeau

By Joseph G Rosengarten

(Read before the American Philosophical Society December 1 1894)

The home of La Fayette at La Grange has long been a point of attraction for many Americans full of admiration for La Fayette and the part he played in the American Revolution The story of his services in behalf of the struggling colonies so well told by Mr Charlemagne Tower Jr in his noteworthy contribution to our history of the Revolution will undoubtedly strengthen and renew the strong affection always entertained in this country for La Fayette so markedly exhibited during his lifetime especially on his last visit to this country and in the reception given to his descendants who came here to join in the celebration of the centennial anniversary of the surrender of Cornwallis at Yorktown In doing honor to La Fayette and to his countrymen for their help in securing American independence we ought not to forget the Rochambeaus father and son the former the General in Chief of the French Allied Army sent to help the American colonies in their struggle against Great Britain the son his Aid de camp who served with distinction and was sent to France to secure that final help fleet men and money with which the long war for Independence was brought to a successful termination by the closing and crowning victory A recent visit to the Chateau de Rochambeau showed that it was full of interest for Americans for there the present owner the Marquis de Rochambeau piously preserves the historical relics of the family and prominent among them are those that marked the Comte de Rochambeau s leading part in the American War of Independence The Chateau itself is of great interest Situated on the banks of the Loire between Blois and Vendôme it is easily accessible and a view of its fine grounds its curious caves its lovely outlook over the valley of the Loire its noble avenue and the beautiful river is of itself a delight to lovers of the picturesque

In the Massachusetts Historical Society *Proceedings* 1892–93 Vol xx p 100 the late Hon Robert C Winthrop describes his then recent visit to the Château de Rochambeau where he found many relics of the old Marquis and Count as he then was of Yorktown memory—the sword which he wore in America his badge as an honorary member of the Cincinnati his baton as a Marshal of France with all his orders and decorations, and a portrait of himself one of a large series of family portraits on the walls On pedestals in the corners were two beautifully wrought miniature cannon inscribed as having been presented to the widow of the old Marquis by Louis XVIII, to take the place of the two British cannon which Washington had presented to Rochambeau after the victory at Yorktown, which had been seized and probably recast during the French Revolution In his bedroom was the original MS of his *Memoirs* printed in

1809 Between the windows was a large portrait one of Peale s original portraits of Washington which had been presented by Washington himself to Rochambeau—a large square or three quarters portrait in military costume with a cannon and other military emblems in the background—in perfect preservation and worthy of being included among the most notable of the numberless portraits of the Father of his Country

A recent visitor giving an account of the Chateau as he saw it in September last in a letter printed in the Philadelphia *Ledger* of October 31 1894 speaks of the fine suits of ancestral armor worn by the Rochambeaus of the sixteenth century around which are draped the American flags presented by Gen Hancock to the present owner certainly an involuntary tribute by the *preux chevalier* of our own army to the prowess of these knights of old He also was among those who on behalf of the Government of the United States welcomed the Marquis de Rochambeau as the leader of the French visitors of 1881 descendants of the gallant soldiers who had shared in the honors of the surrender at Yorktown Thus the connection between the Rochambeau of our own Revolutionary War and the Rochambeau of to day, is one of the pleasant ties that keep alive the friendship of the two countries and make the United States and France sister republics The Comte de Rochambeau left two volumes of *Memoirs* published in Paris in 1809 edited by Leonce de Lancival, which tell the story of his life Born at Vendôme July 1, 1725, and dying at the Chateau de Rochambeau on May 1, 1807 his long life was full of interesting experiences as a soldier and the short episode of his services as Commander in Chief of the French Army sent to help Washington is of itself enough to make him a man of note for all students of American history He entered the French Army as Cornet in 1749 in Saint Simon s Regiment of Cavalry and served with distinction in campaigns in Bohemia, Bavaria and on the Rhine he was made Colonel in 1747 as a reward for his brilliant services at the siege of Namur, and Brigadier for his action at Minorca and Major General for his reorganization of the French Army He served under Marshals Saxe and Richelieu and d Estrées and de Broglie who afterwards sent De Kalb to this country with an offer to become the General in Chief of the army in the impending struggle, a curious episode admirably told by Dr Stille the President of the Historical Society of Pennsylvania Rochambeau himself tells us that after the peace it must have been about 1709 when he was stationed at Strasburg as Inspector of the French Infantry in Alsace he advised the Hereditary Prince of Brunswick to go to America and there play the part of William of Orange in England—make himself sovereign of a superb empire—but the Prince had no idea that the colonies could be united then, or for a long time to come It was a curious coincidence that he should have served under Marechal de Broglie, who seriously hoped to play a leading part in America and that Rochambeau himself should have led the French Army which did such signal service in helping America to achieve its independence, while the same Brunswick

Prince sent his soldiers in the pay of Great Britain to help prevent the colonies from establishing their independence. Rochambeau was a soldier and he had no political aims and ambitions either here or at home. After his brilliant career in the French wars on the Continent he gained fresh honor by his successful reorganization of the French Army in its short experience of peace, and as Governor of the Department of Normandy and Brittany and as Inspector General showed great capacity. In 1778 he organized the force intended for a descent on the English coast, and after twenty years of hard service was made Lieutenant General. He was appointed to the command of the corps intended to be sent to America, consisting of 4000 men, seven ships and money and supplies for the struggling colonies—De Ternay was put in command of the naval force. Arrived at Newport, R. I., after a voyage of seventy days, he disembarked with his contingent, fortified his position, and later on met Washington at Hartford and arranged the plan of the campaign that was to end with such signal honor. He sent his son and Aid de camp back to France to procure additional men and further needed help, and through the younger Rochambeau's vigorous presentation of the case France was led to send more ships and more men and more money. Col. de Rochambeau returned in May with the satisfactory news of another fleet under De Grasse and six hundred more soldiers and a million and a half francs in coin. Colonial bills were then selling at forty per cent discount, and much benefit was derived from a further sum of six million francs which was put at Washington's disposition. The French War Office advised a movement northward to the Penobscot, Nova Scotia and Halifax, but fortunately and wisely left Rochambeau free to join and act with Washington, and it was he who suggested the movement to and operations in Virginia, and at the same time asked for more ships and men and money from the French forces serving in the West Indies.

The Continental currency was practically repudiated by Congress. On June 18 the French corps started to join Washington's Army on the Hudson, making in all a force of 9000 men, enough to keep Clinton in New York and bring Cornwallis to the coast. De Grasse brought from San Domingo Saint Simon's corps of 3000 men and 1,200,000 francs.

Rochambeau divided the 100,000 Louis d'or in his army chest with Washington. The united army crossed the Hudson at King's Ferry, Washington leaving 3000 men on the left bank to cover West Point, the French taking position on the lower Hudson as if for an attack on New York, but soon moving to the Delaware, passing it at Trenton, going through Philadelphia, where Congress reviewed it.

The library of the Historical Society has a copy of a rare book, an abridged translation of the *Memoirs of the Marshal Count de Rochambeau*, by M. W. E. Wright, published in Paris in 1838, giving that part of the French original dealing with his American campaigns. The English of this translation and the queer mistakes in names of men and places make this a very curious performance. It does not seem to have invited any attention to Rochambeau's *Memoirs* or to the broader subject of the French forces in America, since then so fully and ably discussed by the late Mr. Balch in his various elaborate studies of the material he gathered in Paris. In that treasure house of information on the subject, Doniol's *Histoire de la Participation de la France à l'Etablissement des Etats Unis d'Amerique*, Rochambeau's name and deeds are frequently recorded. Chosen to command a descent on the English coast, for his services in the Seven Years War had made him preëminent, for an independent expedition he was suddenly called from the Chateau de Rochambeau, where he had just gone to take possession on the death of his father. He was assigned to the leadership of the force sent to America. He was in consultation with La Fayette as to its details. His instructions are printed in the seventh volume of Sparks' *Washington*, where the letters from Washington to Rochambeau, both in this country and after his return to Europe, show the close ties that bound the two in life long friendship. La Fayette was full of zeal and ambition, and acting as intermediary between Washington and Rochambeau, was at the outset unwilling to defer to the prudence and experience of the elder soldier, but in the end all worked together harmoniously with the best results. Rochambeau treated La Fayette with fraternal tenderness, and even in criticising his impetuous plans spoke of himself as "le vieux pere qui parle a son cher fils." When Washington and Rochambeau met for the first time at Hartford, the former had Knox and La Fayette with him, the latter Ternay, Chastellux, Fersen, Damas, Mathieu Dumas. The results of the interview were entrusted to the younger Rochambeau, who sailed in a ship commanded by La Perouse to seek in France additional help, men, money and ships. Chastellux and Mathieu Dumas both printed their accounts of their life in America, the former in 1786, the latter not until 1839, but both show that France and indeed all Europe were closely following events in America. Washington naturally deferred to the older soldier, but Rochambeau loyally sought to do all he could to assist both in perfecting plans for military operations and in making them successful by the prompt use of all the means at hand. The fifth volume of Doniol gives the letters of Rochambeau to the French War Department, from his accepting the command until he returned to France. It includes copies of his correspondence with Washington and with de La Luzerne, the French Minister in Philadelphia. In his letter accepting his appointment, he recalls his experience in the battles of Laufeldt, Crefeld and Closter camp, and his reasons for a force large enough for all the contingencies of a war in a distant country. Undoubtedly to him is due the fact of later reinforcements of men and ships as well as liberal advances of money. Besides reproducing portraits of Rochambeau from Trumbull, Doniol gives in his fifth volume a portrait owned by the family from a miniature in their possession. Of the son I know of no portrait in this country, although there is a very good one at the Château de Rochambeau, that might with advantage be reproduced to add to the growing gallery of men of note in our history.

In Scharf and Westcott s *History of Philadelphia* Vol i p 414 there is a record of the visit on August 30 1781 of Washington and Rochambeau They were received by the Light Horse and escorted to the city tavern and thence to the house of Robert Morris on Market street between Fifth and Sixth At three o clock they proceeded to the State House and paid their respects to Congress after which they returned to Mr Morris where they dined in company with Samuel Huntington the President of Congress Gens Knox Moultrie and other distinguished officers In the evening the city was illuminated

Mr Westcott in his *History of Philadelphia* says that they dined with the President of Congress [of the State ?] Thomas McKean In the afternoon the vessels in the Delaware displayed their flags and fired salutes On September 3 and 4 the French Army marched through the city Their route was down Front and Second street and past the State House where Thomas McKean as President of the United States being Chief Officer of Congress dressed in black velvet and sword by his side his head covered reviewed them receiving the honors due to a sovereign On his left were Washington and Rochambeau uncovered and on his right the Chevalier de la Luzerne the French Minister After the ceremonies President McKean sent a formal letter to Count Rochambeau expressing the satisfaction of himself and of Congress at the brilliant appearance and exact discipline of the several corps

The regiment Soissonais was exercised on the commons on September 4 in the presence of Congress the French Minister and the Generals and 20 000 spectators The regiment had four field pieces and went through all the evolutions of a skirmish to the delight and satisfaction of the vast crowd On July 15 1782 Washington and Rochambeau attended the fête given by the French Minister at his residence in Philadelphia to 1500 guests in honor of the birthday of the Dauphin of France His house was near Sixth and Chestnut streets where in the evening there were fire works on the large lot on Chestnut street opposite the Minister s residence Mr Gerard was elected a member of the Philosophical Society in 1779, following other illustrious Frenchmen on its rolls Condorcet, Daubenton, Barbeu Dubourg Le Roux Reynall Lavoisier Rozier and in turn followed by Luzerne Marbois La Fayette Chastellux Vergennes Guichen Rochefoucauld Cabanis, Brissot de Warville Du Pont de Nemours and all of these have made their mark on both sides the ocean Thus the Philosophical Society began its admirable method of recognition of those who have rendered great public service both in the old world and in the new

Washington and La Fayette reached Williamsburg September 14 and found there La Fayette strongly posted Barras brought the siege guns by water and then took Viomenil and his troops from Annapolis to Jamestown, where the whole army was united by September 26 On the 28th the siege of Yorktown was begun de Grasse landing 600 men from his fleet to assist the land operations The American Army was on the right the French on the centre and left On October 19 Cornwallis surrendered with 8000 men 214 guns and 22 flags On the 27th an English fleet of 27 sail came to Cape Henry but it was too late The French took possession of the British quarters at Yorktown Gloucester Hampton and Williamsburg Later they rejoined Washington at King s Ferry on the Hudson Returning to France Rochambeau was received with honor by the King and with other French officers who had served with him was meted out decorations and promotions It was on his return from Yorktown that here in Philadelphia as he tells us in his *Memoirs* of all the honors paid him none touched him more than an address presented to him by a deputation of Quakers old men in costumes that he characterizes as quaint from their simplicity who thanked him not for his military success of which they told him they had no admiration but because of his being the friend of mankind and for the perfect order and discipline of his soldiers and he records with satisfaction the fact that in the three campaigns he had made in America there was not a single instance of any quarrel between soldiers of the French Army and those of the American Army a record honorable alike to the soldiers of both nationalities officers and enlisted men too It is eminently characteristic of the man that in this hour of glory he interceded on behalf of De Grasse and secured for him a return to the King s favor

Rochambeau in his *Memoirs* gives a glowing account of the resources of the country and says he thought the United States could some day have a population of thirty millions or more He made a short visit to England and was received most cordially meeting many of Cornwallis officers on a very friendly footing At the outbreak of the French Revolution he had both civil and military duties forced on him and was given the command of the Army of the North He was the last Marshal of France appointed by Louis the XVI and Napoleon in confirming this distinction put him first on the list of his Marshals Forced by ill health to give up his command, he retired to his Chateau was arrested and sent to prison by Robespierre and after nine months confinement, barely escaping the guillotine was released without trial and indeed without formal charges of any kind His son was sent to the West Indies, where he was as successful as possible under the most disadvantageous conditions but finally was made a prisoner of war by the English Paroled by them he paid a visit to Washington, and was received by him with every honor After eighteen months he was exchanged, and that for Gen O Hara one of the English officers captured at Yorktown He again returned to France and was appointed Governor General of San Domingo The father congratulated Berthier, who had served under him in America, on his appointment as Napoleon s Chief of Staff and was presented to Napoleon, who wanted to make him a senator, an honor which he declined on the score of age and bad health but he was made Grand Officer of the Legion of Honor The son was sent back to France as a prisoner by his own rebellious subordinates, and the father went to Paris to defend him against charges made by his enemies but the son was again a prisoner in England in spite of the father's appeal to Cornwallis to remember his release on parole at Yorktown The younger Rochambeau finally returned to France was made General of Division and lost his life at the battle of Leipsic in 1813 The father had died in 1807 and a grandson a young cavalry officer of great promise praised by Davoust and promoted to a staff position lost his leg in the same engagement and was thus compelled to return to civil life He lived and died at Rochambeau and the stately Château is rich in relics of these three generations of gallant soldiers and of many ancestors of distinction in both civil and military life The present Marquis de Rochambeau himself no mean scholar in history and archeology has printed an interesting little volume of sketches written by the younger General de Rochambeau during the last years of the eighteenth century and when he was a prisoner of war in England between 1803 and 1811 they are drawn from his personal knowledge of the men and events hastily described—Danton Robespierre Barrere Carnot Brissot Montesquieu Custines Biron Pichegru among them not a few who had served with the French Army in the American War of Independence, and some of whom achieved great distinction under Napoleon It is curious to find that Gen de Rochambeau suggests that the Duke of Kent be sent to command in Nova Scotia in the hope that the dissatisfied party in the United States might find in him a possible candidate for President making the office hereditary As the elder Rochambeau had suggested to a Brunswick Prince the possibility of founding an empire in America so the younger Rochambeau believed that the English Government had an idea that Americans still cherished a secret affection for the house of Hanover

The Marquis de Rochambeau has printed, too several valuable archeological works and an account of the Chateau de Rochambeau He calls attention to the curious rock grottoes on the hillsides around it the work of more than twenty centuries back for he traces them to the Celts and has found evidences of their handiwork, ancient dwelling places of the very earliest dwellers in the region, and their burial places, too for skeletons of great antiquity and other evidences of Druidical worship of the third century have been found there The estates were in the family from the eleventh to the twelfth century, and the deeds and other muniments of title have been preserved from the fifteenth century, beginning in 1486, although members of the family are known to have taken part in the Crusades, one of them under St Louis of France falling in battle in Egypt in 1251, while another in return for his services in a campaign in Italy was granted as motto for his shield the device *Vivre en preux y mourir* "

From 1516 the Château and estate of Rochambeau gave the name borne by the family, and among them some were distinguished in the wars of the League, others in the navy, one under Jean Bart was made Commodore in 1741, and another Governor of Vendôme was succeeded in that office by his son, who commanded the French forces in the American War of Independence, and later on became Marshal of France. The Chateau itself dates from the twelfth or thirteenth century. It was originally surrounded by walls and flanked with towers. It was rebuilt by Marshal de Rochambeau in the style of his time, and all that recalled the feudal castle disappeared to make room for the architecture of the period. The towers were demolished, but so solid were the foundations that even now when the water of the Loire is clear the old massive stones on which they rested can be seen. Now the Chateau is a large main central building with two wings. These are comparatively modern, but the main body is of very old construction, with massive walls, secret passages and a hidden entrance to what were once the dungeon keep and underground prisons. In face of the main entrance a graceful modern chapel has been constructed, hollowed out of the soft rock. On one side a great series of stables and other houses, on the other the long line of very ancient caves still used for farm purposes, in which the archeological zeal and intelligence of the present owner have unearthed many curious relics of its successive occupants, from those of the stone age through Gallic and Roman days down to historic periods quite within our own memory. Indeed so vast are these artificial caves that in one of the largest a whole troop of cavalry were quartered during the recent French military manœuvres at Chateaudun, horses and men numbering nearly a hundred each being easily accommodated in these roomy, high, airy, dry, well lighted and well ventilated natural dwellings. Where once the crenelated walls of the Chateau commanded the Loire there are now broad terraces and flights of steps and grassy banks leading to the edge of the river, on either side of the Chateau fine gardens, and beyond the river broad meadows planted with fine trees in the style of an English park, so much affected in France in the last century, while a splendid avenue of a mile or two leads from the house between the river on one side and the series of rock caves on the other to the high road leading to Vendome, all in admirable preservation, and in striking contrast to the flat plain that surrounds the famous Château de Chambord and the typical straight lines of small trees that are so frequent throughout Touraine, depriving even its historical châteaux of the beauty of the simple Chateau de Rochambeau. The present Marquis de Rochambeau in his interesting monograph on the Château and its vicinity, gives a series of early charters from the seventh to the thirteenth century for churches and properties now included in its grounds, and the gift of the ground itself under the name of Rochambeau in 14[illegible], the will of the first owner of the present family in 1599, the deed of the establishment of its chapel in 1638, and other interesting papers drawn from the family archives and from local and other public depositories of ancient records. These monographs, that of the younger General de Rochambeau, and that of the present owner of the Château are in the library of the Historical Society of Pennsylvania, which already has on its shelves the *Memoirs* of the Count de Rochambeau, the Commander of the French Allied Troops in the War of American Independence and the archeological writings of the present owner are in the library of the American Philosophical Society. I am very sure that the present owners of the Chateau will be glad to know that the name of Rochambeau is still borne in honor and affection in this country. The official papers of Rochambeau as Commander of the French Army in this country have very properly been obtained by the Government of the United States and are now safely deposited in Washington where no doubt they will be made accessible to students of American history. His private papers are still preserved in the family Chateau where he lived and died and it would be very interesting if his correspondence with those he left there during his service in this country could be made public for we should have from a man of large experience his judgment and opinions of the American patriots and statesmen and soldiers with whom he was in daily communication and we should know how this old French nobleman and soldier was impressed by the country and the people. His printed *Memoirs* are very favorable in every thing he says of the country and of its people but they deal in generalities after the fashion of the day. No doubt they give rather his general impressions as he transmitted them by word of mouth to a literary man who really edited them to suit his own views of how biography ought to be written than with any fidelity to the plain speech of the old soldier whose experiences in a long life must have been so wide and so varied. No doubt too after the rough usage of the French Revolution with actual imprisonment and the threat of the guillotine he looked back on his stay in America at the head of a well disciplined and well equipped force of old soldiers surrounded by officers who represented the flower of the French aristocracy in its best estate as a period of great expectations more than realized by the prosperity of the infant Republic in great contrast to the violent changes in France the sad days of the declining monarchy its violent overthrow the stormy days of the French Revolution its excesses, and the strong measures by which Napoleon reestablished the heavy hand of military power in France and over Europe and the brilliant years of his empire after its first proclamation. When the elder Rochambeau died Napoleon was at the very zenith of his power and when the younger Rochambeau fell at Leipsic Napoleon's star was still in the ascendant. It would be most gratifying to learn whether their private correspondence and family and other papers are still preserved, and to have them printed if not in full at least at sufficient length to give to the growing army of American historical students a better knowledge of the Rochambeaus as they lived and thought and of their opinions of the men of the new country to whose future greatness they had contributed so largely. That they came of old historic and military stock tracing its home back to Celtic days, and their family to ancestral Crusaders, made them all the more helpful for the Republic of the New World

Stated Meeting, November 2, 1894

President, Mr **Fraley**, in the Chair

Correspondence was submitted as follows

A circular from the Executive Committee in honor of Prof Guido Cora, Turin Italy, requesting contributions for his twenty fifth anniversary

The following societies were reported as having been placed on the list to receive the Society s Proceedings Societe Française de Physique, Redaction de la Melusine Paris, France Societa Toscana di Scienze Naturali Il Nuovo Cimento Pisa, Italy, American Academy of Medicine, Easton, Pa American Archæological and Asiatic Association, Nevada Ia, Iowa Masonic Library, Cedar Rapids, Ia Field Columbian Museum, Chicago, Ill, University of Wisconsin Madison, Wis, Historical Society of Southern California, Los Angeles, Cal, California Historical Society San Francisco, Cal, Associacion de Ingeneiros y Arquitectos de Mexico, Mexico, Observatorio Meteorologico Central, Xalapa, Mexico

Accessions to the Library were reported from the Government Geologist, Adelaide Australia, Congrès Internationaux, Moscow, Russia, Finska Litteratur Sallskapet, Helsingfors, Finland, R Societatis Scientiarum, Upsal, Sweden, R Academie des Sciences, Amsterdam, Netherlands, Mittelschweizerische Geographisch Kommerzielle Gesellschaft, Aarau, Switzerland, Société Fribourgeoise des Sciences Naturelles, Fribourg, Switzerland K K Militar Geographisches Institut, Vienna, Austria, Centralbureau der Internationale Erdmessung, K P Geodatische Institut, Berlin, Prussia, Naturforschende Gesellschaft, Emden, Prussia, Senckenbergische Naturforschende Gesellschaft, Frankfurt am Main, Germany, Naturhistorische Gesellschaft, Nurnberg, Bavaria, Verein fur Vaterlandische Naturkunde in Wurtemberg, Stuttgart, Ministère des Travaux Publics, Paris, France, Cobden Club, London, England, Islenzka Fornleif af jelaga, Reykjavik, Agricultural Experiment Station, Burlington, Vt, Society of Natural History, Boston, Mass , N H Colony Historical Society, New Haven, Conn , Society of Natural Sciences, Buffalo, N Y , Geological Survey of Pennsylvania, Dr Bushrod W James, Messrs B S Lyman, MacCalla & Company, Philadelphia, Commissão Geographica e Geologica, San Paulo, Brazil

The following decease of members was announced

Prof J A Froude, London England, October 20, 1894, æt 77

Col Garrick Mallery, Jr Washington, D C, October 25, 1894, æt 63

Dr William Goodell, Philadelphia, October 27 1894, æt 65

On motion the President was authorized to appoint at his leisure a suitable person to prepare the obituary notice of Dr Goodell

The consideration of the amendments to the Laws, postponed from the last meeting, came up as the stated business of the Society

On motion, the consideration of the pending amendments was resumed

Dr Greene moved that the further consideration of Articles 1-5 inclusive, Chapter I, be indefinitely postponed, which motion was carried, ayes 16, nays 7

Sections 6 and 7, Chapter I, were put to a vote and carried as follows

SECTION 6 Such members as reside within *thirty* miles of the hall of the Society and such other members as desire to vote at the meetings and elections shall pay an admission fee of ten dollars, and annually thereafter on the first Friday of January a contribution of five dollars The payment of *one hundred dollars* at one time by a member not in arrears, shall exempt him from all future annual payments

SECTION 7 Members elect residing within thirty miles of the hall shall lose the right of membership unless they subscribe the Laws and pay their admission fee within one year after their election Any member liable to an annual contribution who shall neglect or refuse to pay the same for the term of two years shall be notified by the Treasurer in writing, on or before the second Friday in January after such default, that his rights as a member are suspended and in case the said arrears, together with the contribution due on the first Friday in January after such notice shall not be paid to the Treasurer on or before the said last-named day, the membership of such defaulting member shall be forfeited, his name stricken from the roll and reported to the Society by the Treasurer

On motion, Section 5, Chapter II, of the amendments was indefinitely postponed

The amendments to Chapter VIII as to the Library and the Librarian were referred to the Library Committee

Chapter IX, Section 3, was amended and carried as follows

SECTION 3 *Twenty* qualified voters present at any stated or special meeting shall be a quorum and be competent to elect members dispose of property appropriate money and award premiums but no property shall be alienated or encumbered except by the vote of three fourths of the qualified voters present and given at two successive stated meetings For the transaction of the ordinary business the reception and reference of communications on literary scientific or other subjects the members present shall be deemed competent to act and, in the absence of qualified voters shall form a quorum

Chapter VII, Section 7, was amended and carried as follows

SECTION 7 The President and Senior Secretary of the Society shall be *ex officio* the President and Clerk at their meetings and *seven* of their number shall be a quorum

It was ordered that consideration of the above amendments be made the stated business of the ensuing meeting, copies of the amended regulations to be sent to the members with the meeting notices, with notice that the same will then come up for final adoption

Mr Benjamin Smith Lyman read a paper on "Some Coal Measure Sections near Peytona, West Virginia"

Prof Barker presented a paper entitled "The Atomic Mass of Tungsten," by Prof Edgar F Smith and E D Desi, also one on "The Atomic Mass of Tungsten," by Prof Edgar F Smith and Mary E Pennington

Dr Alfred C Stokes presented (through the Secretaries) a paper entitled, "Notices of Presumably Undescribed Infusoria"

On motion of Dr Greene, it was

Resolved, A Committee of three be appointed to consider the expediency of providing a light collation after each stated meeting of the Society, or at stated intervals, in the Society's rooms, and that the Committee be given power to act provided no expense be incurred by the Society by such action

And the Society was adjourned by the President

Stated Meeting, November 16, 1894

President, Mr FRALEY, in the Chair

Correspondence was submitted as follows

An invitation from the Gesellschaft fur Anthropologie, Ethnologie und Urgeschichte, Berlin, Prussia to attend the twenty fifth anniversary of its foundation, November 17, 1894

Letters of envoy were received from the Royal Academy of Sciences, Amsterdam, Netherlands, K Geologische Landesanstalt und Bergakademie, Berlin, Prussia, R Istituto di Studi Superiori, Firenze, Italia, Museum d Histoire Naturelle, Ministère des Travaux Publics, Paris, France, Agricultural Experiment Stations, Burlington, Vt, Amherst, Mass, Buffalo, N Y, Ithaca, N Y, College Park, Md, Raleigh, N C, Knoxville, Tenn, Agricultural College, Miss, Manhattan, Kans, Brookings, S Dak

Letters of acknowledgment were received from the Universetets Bibliotheket, Christiania, Norway (144), R Norwegian Society of Sciences, Throndhjem (144), K Zoologisch-Botanisch Genootschap, The Hague, Holland (144), Royal Zoological Society (144), Royal Academy of Sciences, Amsterdam, Netherlands (140–142, and Trans, xvii, 3, viii, 1), Musée Teyler, Harlem, Holland (144), Maatschappij van Nederlandsche Letterkunde, Leiden, Holland (144); Anthropologische Gesellschaft (142, 144), K K Geologische Reichsanstalt (144), Dr Aristides Brezina (142, 144), Prof E Suess, Vienna, Austria (142, 144), Verein fur Geographie u Statistik, Frankfurt am Main, Germany (140–142), Naturwissenschaftliche Verein des Reg Bez Frankfurt an der Oder, Prussia

(142, 144) Società Africana d Italia, Naples, Italy (144), Brown University, Providence, R I (144), Oregon Agricultural College, Corvallis (140, 145)

Accessions to the Library were reported from the Physikalisch Technische Reichsanstalt, Messrs Friedlander & Sohn, Berlin, Prussia Schlesische Gesellschaft fur vaterlandische Cultur Breslau, Prussia, Vogtlandische Alterthumsforschende Verein, Hohenleuben, Saxony, Naturwissenschaftliche Verein, Regensburg, Bavaria, Marquis de Rochambeau, Vendome, France, Meteorological Office, London, England Dr Samuel A Green, Boston, Mass , Dr J C Morris, Mr Frederick Prime, Philadelphia, Rev Prof Frank P Manhart, Selins grove, Pa , U S Department of Agriculture, Washington, D C , Pullman's Palace Car Co , Chicago, Ill , Lick Observatory, Mt Hamilton, Prof Dr L Harpérath, Buenos Ayres, S A , Agricultural Experiment Stations, Geneva, N Y , Charleston, W Va , Columbus, O

A cabinet photograph of Mr W W Jefferis was presented by himself

The President reported that he had appointed Messrs Greene, Brinton and Phillips as the Committee on Collation after Meeting provided for in the resolution of November 2, 1894

Owing to the absence of a constitutional quorum, action on the proposed amendments to the Laws was postponed until the next stated meeting of the Society

Pending nominations Nos 1273, 1274, 1276–1303 inclusive and new nomination No 1304 were read

Specimens of the Anaglyph, the latest discovery of Ducos Du Hauron, the French photo scientist, were shown by Mr Julius F Sachse The subject was discussed by Dr J. Cheston Morris, Prof W H. Greene, Dr D G Brinton, Dr George H. Horn and others

Dr Brinton moved that the President be authorized and empowered to appoint, at his leisure, a committee of five members to devise and report an improvement in the Laws respecting the election of members

(The President subsequently appointed Messrs. Brinton, Prime, Morehouse, Greene and Cattell.)

Dr. Morris moved to refer the resolution to Council with directions to report upon the same at the next meeting of the Society.

Dr. Morris' motion, being put to a vote, was lost.

The original motion then being put, was carried.

And the Society was adjourned by the President.

Stated Meeting, December 7, 1894.

President, Mr. **Fraley**, in the Chair.

Correspondence was submitted as follows:

Letters of envoy were received from the Institut Egyptien, Cairo; Australasian Association for Advancement of Science, Adelaide; Royal Society of New South Wales, Sydney, Australia; Verein fur Schlesische Insektenkunde, Schlesische Gesellschaft für Vaterlandische Cultur, Breslau, Prussia; Vogtlandische Alterthumsforschende Verein, Hohenleuben, Saxony; M. de Nadaillac, Paris, France; Royal Observatory, Greenwich, England; Zoölogical and Statistical Societies, London, England; Dr. Isaac Roberts, Starfield, Crowborough, Sussex, England; Bureau of Statistics of Labor, Boston, Mass.; American Academy of Medicine, Easton, Pa., Prof. J. P. Lesley, Philadelphia; Committee on Finance, U. S. Senate, U. S. Coast and Geodetic Survey, Washington D. C.; Agricultural Experiment Stations, Lake City, Fla., New Orleans, La., College Station, Tex., Fort Collins, Colo., St. Anthony Park, Minn., Tucson, Ariz.; Kansas Academy of Science, Topeka; Direccion General de Estadistica, Mexico, Mexico.

Accessions to the Library were reported from the Australasian Association for the Advancement of Science, Adelaide; Government Museum, Madras, India; K. P. Akademie der

Wissenschaften Berlin Prussia Nassauische Verein fur Naturkunde Wiesbaden Prussia Biblioteca N C di Firenze Italia Marquis de Nadaillac M Levasseur Paris France Meteorological Office London England Dr Isaac Roberts Starfield Crowborough Sussex England Royal Observatory Cape of Good Hope Africa H G Pearson Memorial Committee New York American Academy of Medicine Easton Pa Miss Elizabeth Harvey Morison Philadelphia Committee on Finance Washington D C Public Library Cincinnati O Director of the Field Columbian Museum Chicago Ill Direccion General de Estadistica Mexico Mexico Agricultural Experiment Stations New Haven Conn, Byran Tex, Auburn Ala

Mr Charles A Rutter presented to the Cabinet through Dr J C Morris photographs of the Mexican Sacrificial Stone and Mexican Calendar Stone

Dr Charles S Dolley read an obituary notice of the late John M Maisch

The following deaths were announced

Rev James McCosh (Princeton, N J) November 16 1894, æt 83

Hon Robert C Winthrop (Boston Mass), November 16, 1894 æt 85

The following amendments to the Laws laid over from the last meeting were considered and being put to a vote were carried unanimously, a constitutional quorum being present and voting

Sections 9 and 10 Chapter I were put to a vote and carried as follows

SECTION 9 Such members as reside within *thirty* miles of the hall of the Society and such other members as desire to vote at the meetings and elections shall pay an admission fee of ten dollars and annually thereafter on the first Friday of January a contribution of five dollars The payment of *one hundred dollars* at one time by a member not in arrears shall exempt him from all future annual payments

SECTION 10 Members elect residing within thirty miles of the hall shall lose the right of membership unless they subscribe the Laws and pay their admission fee within one year after their election Any member liable to an annual contribution who shall neglect or refuse to pay the same for the term of two years shall be notified by the Treasurer in writing, on or before the second Friday in January after such default, that his rights as a member are suspended, and, in case the said arrears, together with the contribution due on the first Friday in January after such notice, shall not be paid to the Treasurer on or before the said last-named day, the membership of such defaulting member shall be forfeited, his name stricken from the roll, and reported to the Society by the Treasurer."

Chapter IX, Section 3, was amended and carried as follows

"SECTION 3 *Twenty* qualified voters present at any stated or special meeting shall be a quorum, and be competent to elect members, dispose of property, appropriate money, and award premiums, but no property shall be alienated or encumbered, except by the vote of three fourths of the qualified voters present, and given at two successive stated meetings For the transaction of the ordinary business, the reception and reference of communications on literary, scientific or other subjects the members present shall be deemed competent to act, and, in the absence of qualified voters, shall form a quorum "

Chapter VII, Section 7, was amended and carried as follows

"SECTION 7 The President and Senior Secretary of the Society shall be, *ex officio*, the President and Clerk at their meetings, and *seven* of their number shall be a quorum "

On motion the Committee was discharged

The following report was presented from the Committee appointed November 16, 1894, to report a new method of electing members:

The Committee appointed by resolution of the Society dated November 16, to report desirable alterations in the By Laws touching the election of members, recommend as follows ·

That Sections 2, 3 and 4 of Chapter I of the Laws of the Society be repealed, and that in their place the following laws be substituted.

"2. A Standing Committee on Resident Membership shall be elected by the Society, on the third Friday in January, to consist of six members, the term of office of two of whom shall expire each year, and none of whom shall be eligible for immediate reelection, the function of which Committee shall be to examine carefully the claims of each candidate offered for membership and to which Committee all nominations for membership shall be sent, signed by at least three members of the Society, none of whom shall be members of the Committee on Nominations

"3 That at the meeting of the Society previous to that assigned for the election of members, the Committee on Nominations shall report to the Society on all nominations which were received by it previous to its last meeting, reporting which candidates received an affirmative vote of at least four out of the six members of the Committee, and which candidates received less than that number; and this report shall be printed and sent, under seal to each resident member of the Society at least one week before the evening of the election provided however that said Committee before reporting to the Society the names of any candidates who have received less than four affirmative votes shall notify the proposers of such candidates in order that their names may be withdrawn if their proposers so desire

4 Nominations for non resident membership shall be signed by at least three members of the Society who are not of Council and sent in to the Board of Officers and Council who shall recommend for election such as they deem desirable and the election of such shall be in the same manner and at the same time as above specified for resident members

And to add to Section 6 of Chapter I these words

And any candidate shall be deemed duly chosen who shall have received in his favor a majority of the votes cast

D G BRINTON *Chairman*
FREDERICK PRIME
GEORGE R MOREHOUSE
W C CATTELL
WILLIAM H GREENE

The same was ordered to be made the special order of business for the next meeting notice thereof to be sent to the members

The Committee on Dr Cope s Paper reported favorably on its publication and was discharged

The Committee on Collation reported, and was indefinitely continued

Pending nominations Nos 1273, 1274, 1276–1303 (inclusive) were read, new nomination 1304 was read, and the Society was adjourned by the President

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Stated Meeting, December 21, 1894

President, Mr FRALEY, in the Chair

Correspondence was submitted as follows

A circular letter was received from the R Accademia di Scienze Lettere ed Arti, Modena, Italy, announcing the prizes which have been awarded during 1893–94. Also one from the same Society announcing the death of its Secretary, Cav Avv Pietro Bortolotti

Letters of acknowledgment were received from the Royal Society of Northern Antiquities Copenhagen Denmark (144), Colonial Museum, Haarlem Holland (144) Friesch Genootschap, Leeuwarden, Netherlands (144), Drs Friedrich S Krauss (142, 144) Friedrich Muller, Vienna Austria (142 144 145) Naturforschende Gesellschaft des Osterlandes, Altenburg Germany (142 144) Naturforschende Gesellschaft Bamberg, Bavaria (142, 144) K Bibliothek (144) Redaction der *Naturwissenschaftliche Wochenschrift* Berlin, Prussia (142, 144), Naturwissenschaftliche Verein Bremen Germany (145) K Leopoldina Carolina Academie der Deutschen Naturforscher, Halle a S, Prussia (144) Dr Henri de Saussure, Geneva, Switzerland (144), R Accademia dei Lincei R Comitato Geologico d Italia, Rome, Italy (144), Société Linnéenne, Bordeaux, France (144) Faculté des Sciences, Marseilles, France (145) Bureau des Longitudes (142) Redaction *Cosmos* (145), Mr A Des Cloizeaux (144), Profs A Daubree (144), E Mascart (145) Marquis de Nadaillac Paris, France (145), Mr Samuel Timmins Arley, Coventry, Eng (145), University Library, Cambridge, Eng (145) Royal Society, British Association, Zoological Society, R Meteorological Society, R Institution of Great Britain R Astronomical Society R Statistical Society, Linnean Society, Victoria Institute, Mr Archibald Geikie, London, Eng (145), Dr Isaac Roberts, Starfield, Crowborough, Sussex, Eng (145), Royal Society of Edinburgh, Prof James Geikie, Edinburgh, Scotland (145), Lord Kelvin, Glasgow, Scotland (145), Royal Dublin Society, Dublin, Ireland (145), Nova Scotian Institute of Science, Halifax (138) American Antiquarian Society, Worcester, Mass (140), Brown University, Providence, R I (144), Society Natural Sciences, Buffalo, N Y (144), Geological Society of America, Rochester, N Y (135, 140), Messrs Robert P Field, William W Jefferis, Philadelphia (145), Mr E T im Thurn, Georgetown, British Guiana (142, 144)

Accessions to the Library were reported from the R Ministero della Instruzione Publica, Padova, Italia, R Accademia di Scienze, Lettere ed Arti, Modena, Italy, Societa Reale, Naples, Italy, R Istituto Veneto di Scienze Lettere ed Arti Venice, Italy, Marquis de Nadaillac, Paris, France, Yorkshire Geological and Polytechnic Society, Halifax, Eng , Victoria Institute, London, Eng , Radcliffe Observatory, Oxford Eng , John Hopkins University, Baltimore, Md Bureau of Ethnology, United States Geological Survey of the Rocky Mountain Region, Washington, D C , Secretaria di Fomento Mexico, Mexico

The following death was announced

Prof Paul Albrecht, Hamburg, Germany

Mr Rosengarten read a paper entitled "The Château de Rochambeau"

Publication Committee reported that it had ordered the publication of Dr Cope's paper for the *Transactions*

Pending nominations Nos 1273, 1274, 1276–1303 (inclusive) and new nomination No 1304 were read

Owing to the absence of the quorum required by the Laws of the Society, the report of the Finance Committee was not acted upon, the appropriations were not passed, and candidates for membership were not balloted for

And the Society was adjourned by the President

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LIST OF SURVIVING MEMBERS

OF THE

AMERICAN PHILOSOPHICAL SOCIETY,

HELD AT PHILADELPHIA

FOR

PROMOTING USEFUL KNOWLEDGE.

Corrected to January 4, 1895,

BY

HENRY PHILLIPS, JR.,

A Secretary of the Society

List of surviving Members of the American Philosophical Society held at Philadelphia for Promoting Useful Knowledge

The addresses here given so far as known are at the present time Corrections of this list are respectfully solicited

A name printed in *italics* indicates that the Society is uncertain as to whether such member is still living and desires information on the subject

The Society will be happy to receive *photographs* (cabinet size preferred) of such of its members as have not already sent

A

	Name	*Date of Election*	*Present Address*
1687	ABBE CLEVELAND	July 21 1871	Army Weather Bureau Washington D C
2170	ABBOTT CHARLES C	Dec 20 1889	Bristol Pa
1463	ABBOT HENRY L	April 18 1867	New York city N Y
1609	ÅCKERMAN RICHARD	July 21 1876	Stockholm Sweden
1713	ACLAND HENRY W	Jan y 17 1871	Oxford England
2198	ADAM LUCIEN	Dec 17 1896	Rennes France
2081	ADAMS H B	May 21 1886	Baltimore Md
1381	*Adamson Rev John C*	July 18 1856	
1779	AGASSIZ ALEXANDER	April 16 18 5	Cambridge Mass
1642	AGASSIZ, ELIZABETH	Oct 15 1869	
1860	ALISON ROBERT H	May 3 1878	Ardmore Pa
1869	ALLEN JOEL ASAPH	Sept 20 1878	New York N Y
1927	AMES CHARLES G	Jan y 21 1881	Boston Mass
2064	ANDERSON GEORGE B	Feb y 19 1886	West Point N Y
2164	ANGELL, JAMES B	Oct 18 1889	Ann Arbor Mich
1122	*Angelis Pedro de*	Jan y 17 1840	*Buenos Ayres S A*
2224	APPLETON WILLIAM HYDE	May 19 1893	Swarthmore Pa
2102	ARGYLL, DUKE OF	May 21 1886,	London England
1761	ARMSTRONG WM GEORGE	July 17 1874,	Newcastle-on Tyne England
1996	ASHHURST JOHN	Jan y 18, 1884	Philadelphia
2012	ASHHURST RICHARD L	April 18 1884	

B

	Name	Date of Election	Present Address
1995	Bache R Meade	July 18 1884	Philadelphia
1832	Bache Thomas Hewson	Feby 1877	
1680	Baird Henry Carey	July 1 1869	
1991	Baird Henry M	Jany 18 1891	Yonkers N Y
2075	Baker William S	May 1 1896	Philadelphia
2101	Ball Robert S	May 15 1891	Dublin Ireland
1930	Barber Edwin Atlee	April 1 1881	West Chester Pa
1818	Barcena Mariano	Feby 2 1877	Mexico
1741	Barker George F	April 18 1873	Philadelphia
2011	Barker Wharton	April 18 1884	
1909	Bartholow Roberts	April 16 1880	
1133	Bartlett W H C	April 17 1854	Yonkers N Y
2113	Bastian Adolph	Dec 17 1888	Berlin Germany
1968	Bell Alexander Graham	July 1 1882	Washington
1906	Bell Joseph Snowden	July 2 1880	Philadelphia
1802	Bell Lowthian	April 1 1876	Northallerton England
2128	Bessemer Sir Henry	Feby 1 1884	Surrey England
2140	Biddle Alexander	Feby 17 1888	Philadelphia
2134	Biddle Arthur	Dec 21 1888	
1920	Biddle Cadwalader	Oct 15 1880	
1831	Biddle Craig	Feby 1877	
2144	Billings John S	Feby 18 1887	Washington D C
2157	Blair Andrew A	May 17 1889	Philadelphia
1954	Blair Thomas S	Jany 19 1886	Tyrone Pa
1660	Blake William Phipps	Oct 21 1870	New Haven Conn
1900	Blasius William	Oct 1 1878	Philadelphia
1400	Blodget Lorin	April 19 1852	
1444	Bohtlingk Otto	Jany 17 1862	Leipzig Germany
2047	Bonwill W G A	Oct 16 1885	Philadelphia
1126	Boye Martin H	July 17 1840	Coopersburg Pa
1826	Brackett Cyrus Fogg	Feby 2 1877	Princeton N J
2083	Branner John C	May 21 1886	Stanford University Cal
2190	Brezina Aristides	May 21 1886	Vienna Austria
1036	Brinton Daniel G	April 16 1869	Philadelphia
2089	Brinton John H	Feby 19 1886	
1745	Britton J Blodget	Oct 17 1873	
2080	Brooks William Keith	May 21 1886	Baltimore Md
1881	Brown Arthur Erwin	April 18, 1879	Philadelphia
1547	Brush George J	Jany 20 1865	New Haven Conn
1658	Bullock Charles	Oct 15 1869	Philadelphia
1452	Bunsen Robert W	Jany 17 1862	Heidelberg Germany
2007	Burk Jesse Y	Jany 18 1894	
1938	Butler William	April 15 1881	West Chester Pa

C

1788	Campbell John Lyle	July 16 1875	Crawfordsville Ind
1606	Canby William Marriatt	Oct 16 1868	Wilmington Del
2051	Cannizzaro Tommaso	Oct 16 1885	Messina Italy
1781	Capellini Giovanni	April 18 1873	Bologna Italy
1796	Carll J F	Oct 15 1875	Pleasantville Pa
2180	Carrillo Crescencio	Dec 17 1886	Merida Yucatan
1911	Carson Hampton L	April 16 1880	Philadelphia
1707	Cassatt Alexander Johnson	Oct 16 1872	
2147	Castner Samuel Jr	Dec 16 1887	

	Name	Date of Election	Present Address
2152	Cattell J McKeen	May 18 1888	Garrison on Hudson N Y
1675	Cattell William C	Jan y 20 1871	Philadelphia
1908	Chance Henry Martyn	April 16 1880	
1783	Chandler C F	April 16 1875	New York N Y
1778	Chapman Henry C	April 11 1875	Philadelphia
2132	Charencey C Mis Hyacinthe de	Dec 17 1898	Paris France
2159	Clark Clarence H	May 17 1899	Philadelphia
1717	Clarke Thomas C	Jan y 17 1873	New York N Y
1983	Claypole E W	Jan y 19 1883	Akron Ohio
18[illegible]	Cloizeaux Des A	Oct 18 1879	Paris France
1999	Cohen J Solis	Jan y 18 1884	Philadelphia
1[illegible]5	Cope Edward D	Jan y 19 1866	
1567	Coppee Henry	Jan y 19 1866	Bethlehem Pa
2109	Cora Guido	Dec 17 1896	Turin Italy
1867	Coues Elliott	Sept 20 1878	Washington D C
166[illegible]	Cox J D	April 15 1870	Cincinnati O
1672	Coxe Eckley B	Oct 21 1870	Drifton Pa
2207	Cramp Charles H	Dec 16 1892	Philadelphia
1830	Crane Thomas F	Feb y [illegible] 1877	Ithaca N Y
2100	Crookes William	May 21 1896	London England
2217	Cruz Fernando (of Guatemala)	Dec 20 1893	
[illegible]	Curwin John	April 18 1861	Warren Pa

D

1567	Da Costa J M	Oct 19 1866	Philadelphia
2214	Daly Charles P	May 19 1893	New York N Y
18[illegible]4	Dana James D	July 21 18[illegible]	New Haven Conn
1800	Dannefeld C Juhlin	April 21 1876	Stockholm Sweden
1516	Daubrée A	July 17 1863	Paris France
1811	Davenport Samuel	Oct 20 1876	Adelaide S Australia
1557	Davidson George	Jan y 19 1866	San Francisco Cal
1923	Dawkins William B	Oct 15 1880	Manchester England
1468	Dawson John W	April 18 1862	Montreal Canada
2101	Delgado Juan de Dias de la Rada y	Dec 17 1896	Madrid Spain
2206	Dercum Francis X	Dec 16 1892	Philadelphia
2013	Dickson Samuel	April 19 1884	
2208	Dixon Samuel G	Dec 16 1892	
2108	Dolley Charles S	Dec 17 1896	
2089	Donner Otto	May 21 1896	Helsingfors Finland
1946	Doolittle C L	Oct 21 1881	Bethlehem Pa
1839	Douglass James Jr	April 20 1877	Spuyten Duyvil N Y
1924	Draper Daniel	Oct 1 1880	New York, N Y
1787	Drown Thomas M	July 16 1875	Boston Mass
1918	Du Bois Patterson	Oct 15 1880	Philadelphia
1878	Dudley Charles Benjamin	Jan y 17 1879	Altoona Pa
2068	Duncan Louis	Feb y 19 1896	U S Navy
1578.	Dunning George F	Jan y 18 1867	Farmington, Conn
1727	Dupont Edouard	April 18, 1873,	Brussels Belgium
2227	DuPont Henry A	Feb y 16 1894	Winterthur Del
2086.	Duruy, Victor	May 21 1896,	Paris, France.
1679	Dutton Clarence E	Jan y 20 1871	Washington D C

E

2103	Easton Morton W	Dec. 17 1896,	Philadelphia.
1917	Eckfeldt, Jacob B	Oct 15, 1880,	"

	Name	*Date of Election*			*Present Address*
1826	EDDY HENRY T	Feb'y		1877	Terre Haute Ind
1686	ELIOT CHARLES W	April	1	1871	Cambridge Mass
1981	EMMONS S F	Jan'y	19	1883	Washington D C
1943	EVANS JOHN	Oct	21	1881	Hemel Hempstead Eng

F

2180	FIELD ROBERT PATTERSON	May	16	1890	Philadelphia
1901	FLINT AUSTIN JR	April	16	188	New York N Y
1621	FLOWER WM HENRY	Jan'y	1	1869	London England
1875	FOGGO EDWARD A	Oct	18	1878	Philadelphia
2197	FORBES GEORGE	Oct	16	1891	London England
11 0	FRALEY FREDERICK	July	18	18[illegible]	Philadelphia
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2170	FULLERTON GEORGE S	May	1	1890	
1789	FULTON JOHN	April	18	1871	Johnstown Pa
1914	FURNESS HORACE HOWARD	April	16	1880	Philadelphia
1130	FURNESS WILLIAM H	April	17	1840	

G

1988	GARRETT PHILIP C	April	20	1883	Philadelphia
2079	GATES M E	May	21	188	Amherst Mass
[illegible]	GATSCHET ALBERT S	Oct	17	1884	Washington D C
1897	GEIKIE ARCHIBALD	Jan'y	16	1880	London England
1808	GEIKIE JAMES	April	21	1871	Edinburgh Scotland
2067	GENTH F A JR	Feb'y	19	1886	Philadelphia Pa
1355	GIBBS OLIVER WOLCOTT	July	21	1854	Cambridge Mass
1587	GILL, THEODORE NICHOLAS	July	19	1867	Washington D C
1800	GILMAN DANIEL C	April	21	1876	Baltimore Md
1940	*Giraldes J P C Cassado de*	July	20	1827	
1950	GLADSTONE WM EWART	Oct	21	1881	London England
2212	GOODALE GEORGE LINCOLN	Feb	17	1893	Cambridge Mass
2162	GOODE G BROWN	Oct	18	1889	Washington D C
1690	GOODFELLOW EDWARD	Jan'y	20	1871	
2203	GOODWIN HAROLD	May	20	1892	Philadelphia
1271	GOULD BEN APTHORP	Jan'y	17	1851	Cambridge Mass
1851	GRAY ELISHA	Jan'y	18	1878	Chicago Ill
2222	GREEN SAMUEL A	Oct	20	1893	Boston Mass
1605	GREEN TRAILL	Oct	16	1868	Easton Pa
1504	GREEN WILLIAM HENRY	April	17	1863	Princeton N J
1880	GREENE WILLIAM H	April	18	1879	Philadelphia
2155	GREGORIO IL MARCHESE ANTONIO DE	Dec	21	1888	Palermo Sicily
2159	GREGORY HENRY D	May	17	1889	Philadelphia
2188	GREGORY CASPAR RENÉ	May	15	1891	Leipzig
1229	*Grimaldi, Cava*	Oct	16	1844	*Naples Italy*
1939	GRISCOM WM WOODNUTT	April	15	1881	Haverford Pa
1815	GROTE AUGUSTUS RADCLIFFE	Oct	20	1876	
2090	GUBERNATIS, ANGELO DE	May	21	1886	Florence Italy
1488	GUYANGOS PASCUAL DE	April	19	1861	London England

H

2054	HAECKEL, ERNST	Oct	16	1885	Jena Prussia
1658	HALE EDW EVERETT	Jan'y	21	1870	Roxbury Mass
1709	HALE HORATIO	Oct	18	1872	Clinton Canada

	Name	Date of Election.	Present Address.
1858	Hall Asaph	Jany 18 1878	Washington D C
1795	Hall Charles Edward	Oct 15 1875	Westport N Y
2219	Hall Isaac H	May 19 1893	New York N Y
1356	Hall, James	July 21 1854	Albany N Y
2027	Hall Lyman B	Jany 16 1885	Haverford Pa
1412	Hammond William A	Oct 21 1859	New York N Y
2194	Hamy E T	May 15 1891	Paris France
1937	Harding George	Jany 20 1881	Philadelphia
2136	Harris Joseph S	May 20 1887	
1827	Hart James Morgan	Feby [illegible] 1877	Ithaca N Y
1510	Hartshorne Henry	July 17 1863	Philadelphia
1764	Hauer Franz Ritter von	Oct 16 1874	Vienna Austria
1661	Haupt Hermann	April 21 1871	St Paul Minn
1862	Haupt Lewis M	May 3 1878	Philadelphia
2082	Hayes R Somers	May 21 1886	New York N Y
2071	Hays J Minis	Feby 19 1886	Philadelphia
2165	Hazlehurst Henry	Oct 18, 1889	
1985	Heilprin Angelo	April 20 1883	
2218	Hewett Waterman T	May 19 1893	Ithaca N Y
1963	Hill Hamilton Andrews	April 21 188	Boston Mass
2110	Hilprecht Hermann V	Dec 17 1886	Philadelphia
1769	Himes Charles Francis	Oct 16 1874	Carlisle Pa
1663	Hitchcock Charles Henry	April 15 1870	Hanover N H
2160	Hoffman Walter J	Oct 18 1889	Washington D C
2068	Holland James W	Feby 19 1886	Philadelphia
1624	Hooker Joseph D	Jany 15 1869	London England
2224	Hoppin J M	Oct 20 1893	New Haven Conn
1607	Horn George Henry	Oct 16 1868	Philadelphia
2070	Horner Inman	Feby 19 1886	
1941	Hotchkiss Jedediah	Oct 21 1881,	Staunton Va.
1696	Hough George W	Jany 19 1872	Evanston Ill
1698	Houston Edwin J	Jany 19 1872,	Philadelphia
2148	Houston Henry H	May 20 1887	
2094	Hovelacque Abel	May 21 1886	Paris France
1843	Humphrey H C	July 20 1877	
2211	Humphrey James Ellis	Dec 16 1892	Baltimore Md.
1628	Huxley Thomas Henry	Jany 15 1869	London England.
1426	Hyrtl Joseph	July 20 1860	Vienna Austria

I

2052	Im Thurn Everard F	Oct 16 1885	Georgetown British Guiana.
2221	d Invilliers Edward Vincent	May 19 1893	Philadelphia
1778	Ingham Wm Armstrong	April 16 1875	

J

2010	James Edmund J	April 18 1884	Philadelphia
1958	Jannet Claudio	April 15 1881	Paris France
2049	Jayne Horace	Oct. 16 1885	Philadelphia
1964	Jefferis William W	Jany 20 1882	
2017	Jordan Francis Jr.	April 18 1884	

K

1969	Kane Elisha Kent	April 20 1883,	Kane Pa
2169	Keane, John J	Dec 20 1889	Washington, D C
2021	Keen William W	July 18 1884	Philadelphia.

	Name	*Date of Election*	*Present Address*
1792.	KELVIN LORD (WM THOMSON)	April 18 1873	London England
2118.	KIEPERT HENRI	Dec 17 1886	Berlin Prussia
1161	KENDALL E OTIS	Jany 1 1842	Philadelphia
1708	KING CLARENCE	Oct 19 1872	New York N Y
1284	KIRKWOOD DANIEL	April 18 1851	Riverside Cal
1767	KONIG GEORGE A	Oct 16 1874	Houghton Mich
2167	KRAUSS FRIEDERICH S	Dec 20 1889	Vienna Austria

L

1694	LAMBERT GUILLAUME	Jany 10 187[illegible]	Louvain Belgium
1858	LANDRETH BURNET	Jany 18 1878	Bristol Pa
1781	LANGLEY SAMUEL P	April 16 1873	Washington D C
1721	LA ROCHE C PERCY	Jany 17 1873	Philadelphia
1711	LAUTH FRANZ JOSEPH	Oct 19 1872	Munich Bavaria
1974	LAWES JOHN BENNETT	Jany 1 1883	Rothamsted Herts Eng
1595	LEA HENRY CHARLES	Oct 16 1867	Philadelphia
1787	LE CONTE JOSEPH	April 18 1873	Berkeley Cal
1966	LEHMAN AMBROSE E	April [illegible] 1883	Philadelphia
2182	LELAND CHARLES G	May 1 1890	London Eng
2174	LE MOINE J M	Dec 20 1889	Quebec Canada
1984	LE ROY BEAULIEU PAUL	April 15 1881	Paris France
1882.	LESLEY J PETER	July 13 1856	Philadelphia
1870	LETCHWORTH ALBERT S	Jany 18 18[illegible]	
2065	LEVASSEUR EMILE	May 21 1886	Paris France
1415	LEWIS FRANCIS W	Jany 20 1860	Philadelphia
1756	LOCKYER JOSEPH NORMAN	April 17 1874	London England
2202	LOW SETH	Feb 19 1892	New York N Y
1872	LONGSTRETH MORRIS	Sept 20 1878	Philadelphia
2019	LUBBOCK JOHN	July 18 1884	London England
2003	LUDLOW WILLIAM	Jany 18 1884	U S A
1629	LYMAN BENJAMIN SMITH	Jany 15 1869	Philadelphia

M

2107	MACALISTER JAMES	Dec 1 1886	Philadelphia
2209	MACFARLANE JOHN M	Dec 16 1892	Lansdowne Pa
2042.	MALLET JOHN WM	Jany 16 1885	University of Virginia Va
1847	MANSFIELD IRA FRANKLIN	Jany 18 1878	Cannelton Pa.
1857	MARCH FRANCIS ANDREW	Jany 18 1878	Easton Pa
1861.	MARKS WILLIAM D	May 3 1878	Philadelphia
1604.	MARSH OTHNIEL C	Oct 15 1868	New Haven Conn
2076	MARSHALL JOHN	May 21 1886	Philadelphia
1018.	*Martinez Juan José*	April 20 1832	*Spain*
2184,	MASCART E	Dec 19 1890	Paris France
1572	MASON ANDREW	Jany 18 1867	New York N Y
2196	MASPERO GASTON	May 15 1891	Paris, France
1654.	MAYER ALFRED M	Oct. 15 1869	Hoboken N J
1885.	MCCREATH ANDREW S	July 18 1879	Harrisburg Pa.
1821	MCKEAN WILLIAM V	Feby 2 1877	Philadelphia
2004	MCMASTER JOHN BACH	Jany 18 1884	
1677	MEEHAN THOMAS	Jany 20 1871	
1908	MERRICK, JOHN VAUGHAN	April 16 1880	
1947	MERRIMAN MANSFIELD	Oct. 21 1881	Bethlehem Pa
1744	MESCHERT MATHEW HUIZINGA	Oct 17 1873	Douglassville Pa.

	Name	*Date of Election*	*Present Address*
2142	Michael Helen Abbott	May 20 1887	Philadelphia
2175	Mitchell James T	Feb y 21 1890	
1461	Mitchell S Weir	Jan y 17 1862	
2114	Monier Williams Monier	Dec 17 1886	London England
1891	Moore Gideon E	Oct 1 1875	New York N Y
2029	Moore James W	Jan y 16 1885	Easton Pa.
1841	Morehouse George R	April 20 1877	Philadelphia.
1054.	*Morelli*	Jan y 15 1846	*Naples Italy*
1976.	Morris J Cheston	Jan y 1 1883	Philadelphia
2228	Morris John G	Oct 20 1893	Baltimore Md
1577	Morton Henry	July 18 1867	Hoboken N J
2121	Much Matthæus	Dec 17 1886	Vienna Austria
1868	Muhlenberg F A	Sept 20 1978	Reading Pa
2120	Mueller Friedrich	Dec 17 1886	Vienna Austria.
1486	Mueller F Max	Jan y 16 1863	Oxford England
2192	Munroe Charles E	May 15 1891	Washington D C
2062	Murdock J B	Feb y 19 1886	U S Navy
1937	Murray James A H	April 15 1881	Oxford England

N

2087	Nadaillac Marquis de	May 21 1886	Paris France
1852	Newcomb Simon	Jan y 18 1878	Washington D C
158	Newton Hubert Anson	April 19 1869	New Haven Conn
1709	Nichols Starr Hoyt	July 19 1872	New York N Y
2060	Nikitin Serge	Feb y 19 1886	St Petersburg Russia
1805	Nordenskiold Adolf Eric	April 21 1876	Stockholm Sweden
1712.	Norris Isaac	Oct 18 1872	Philadelphia
2106	Norris William F	Dec 17 1886	
2046	North Edward	Oct 16 1885	Clinton N Y

O

2072	Oliver Charles A	Feb y 19 1886	Philadelphia
1715	Oliver James E	Jan y 17 1873	Ithaca N Y
2195	Oppert Jules	May 15 1891	Paris France
2135	Osborn Henry F	Feb y 18 1887	New York N Y
2039	Osler William	Jan y 16 1885	Baltimore Md

P

1868	Packard A S Jr	Sept 20 1878	Providence R I
1578	Packard John H	Jan y 18 1867	Philadelphia
1331	Paget James	Jan y 20 1854	London England
1964	Pancoast William Henry	Jan y 19 1883	Philadelphia
2086	Parvin Theophilus	Jan y 16 1885	
2056	Pasteur Louis	Oct 16 1885	Paris France
2035	Patterson C Stuart	Jan y 16 1885	Philadelphia
1282	Patterson Robert	April 18 1851	
1320	Patterson Thomas L	April 15, 1853	Cumberland Md
2213	Pattison Robert E	Feb 17 1893	Harrisburg Pa
1772.	Pearse John B	Jan y 15 1875	*Boston, Mass*
1859	Peirce C Newlin	May 3 1878	Philadelphia.
1723	Pemberton Henry	Jan y 17 1873	
2104.	Peñafiel, Antonio	May 21 1886	Mexico
2078	Pennypacker Samuel W	May 21 1886	Philadelphia
1518	Penrose R A F	July 17 1863	

	Name	*Date of Election*			*Present Address*
2059	Pepper Edward	Feb y	19	1886	Paris
1666	Pepper William	July	15	1870	Philadelphia
951	*Pereira José Maria Dantas*	April	18	1829	*Lisbon Portugal*
1844	Phillips Henry Jr	Feb y	2	1877	Philadelphia
1760	Platt Franklin	July	17	1874	
2127	Platzmann Julius	Dec	17	1886	Leipzig Germany
2053	Pomialowsky John	Oct	16	1885	St Petersburg Russia
1589	Porter Thomas Conrad	Oct	21	1864	Easton Pa
2044	Potts William John	Oct	16	1885	Camden N J
2097	Postgate J P	May	21	1886	Cambridge England
2161	Powell J W	Oct	18	1889	Washington D C
1619	Prestwich Joseph	Jan y	1	1869	Shoreham England
1592	Price J Sergeant	Oct	18	1867	Philadelphia
1780	Prime Frederick Jr	April	16	1875	
2088	Pulszky Francis	May	1	1886	Buda Pesth Hungary
1758	Pumpelly Raphael	April	17	1874	Newport R I

R

1736	Rand Theodore D	April	18	1873	Philadelphia
1849	Randall F A	Jan y	18	1878	Warren Pa
1644	Rawlinson George	Oct	15	1869	Oxford England
1765	Rawson Rawson W	Oct	16	1874	London
2099	Rayleigh Lord	May	21	1886	Essex England
1781	Raymond Rossiter W	April	16	187[illegible]	New York N Y
1585	Raynolds William F	April	19	1867	Detroit Mich
1591	Read John Meredith	July	19	1867	
2077	Reed Henry	May	21	1886	Philadelphia
1889	Remsen Ira	July	18	1879	Baltimore Md
1948	Renard A	Oct	21	1881	Brussels Belgium
1343	Renard Charles	Jan y	20	1854	Moscow Russia
1890	Renevier E	July	18	1879	Lausanne Switzerland
1816	Reuleaux F	Feb y	2	1877	Berlin Prussia
2122	Réville Albert	Dec	17	1886	Paris France
1500	Richardson Benjamin Ward	April	17	1863	London England
1608	Riley Charles V	April	21	1870	Washington D C
2226	Roberts Isaac	Oct	20	1893	Starfield Crowborough Sussex England.
1957	Robins James W	April	21	1882	Philadelphia
1390	Rogers Fairman	Jan y	16	185[illegible]	Newport R I
2177	Rogers, Robert W	Feb y	21	1890	Madison N J
1462	Röhrig F L O	April	18	1862	Los Angeles Cal
2050	Rollett Hermann	Oct	16	1885	Vienna Austria
1907	Rood Ogden N	April	16	1880	New York N Y
1964	Rosny de Léon	July	21	1882	Paris France
1732	Rossi Giovanni Battista	April	18	1873	Rome Italy
2198	Rosengarten Joseph G	Oct	16	1891	Philadelphia
1718	Rothermel Peter F	Jan y	17	1873	Linfield Pa
1838	Rothrock Joseph T	April	20	1877	Philadelphia
1264	Ruschenberger W S W	Oct	19	1849	
1620	Rutimeyer Carl L	Jan y	15	1869	Basel Switzerland
2109	Ryder John A	Dec	17	1886	Philadelphia

S

2230	Sachse Julius F	Feb y	16	1894	Philadelphia
1766	Sadtler Samuel Philip	Oct	16	1874	
2146	Sajous Charles E	Feb y	17	1888	Paris France

Name	*Date of Election*	*Present Address*
1563 Sandberger Fridolin	April 20 1866	Würtzburg Bavaria
1958 Sargent Charles Sprague	April 21 1882	Brookline Mass
1780 Saussure, Henri de	April 18 1873	Geneva Switzerland
2211 Schaffer Charles	Feb y 17 1893	Philadelphia
1496 Schott Charles Anthony	April 17 1863	Washington D C
1864 Schurz Carl	Sept 20 1878	
1725 Sclater Philip Lutley	April 18 1873	London England
1913 Scott Lewis A	Oct 15 1880	Philadelphia
2117 Scott W B	Dec 17 1886	Princeton N J
1870 Scudder, Samuel Hubbard	Sept 20 1878	Cambridge Mass
1883 Seiler Carl	April 18 1879	Philadelphia
1704 Sellers Coleman	July 19 1872,	
1583 Sellers William	April 15 1864	
1770 Selwyn Alfred R C	Oct 16 1874	Montreal Canada
1728 Selys de Longchamps	April 18 1873	Liége Belgium
2057 Sergi Giuseppe	Oct 16 188	Rome Italy
1965 Sève de Bar Edouard	July 21 188	Ramsgate England
2076 Sharp Benjamin	May 21 1886	Philadelphia
1944 Sharples Philip Price	Oct 21 1881	West Chester Pa
1960 Sharples, Stephen Paschall	April 21 188	Boston Mass.
1797 Sherwood Andrew	Oct 15 1875	Mansfield Pa
1822 Shields Charles W	Feb y 2 1877	Princeton N J
1582 *Shiess Carl*	April 15 1864	*Strassburg Germany* (?)
2146 Smith Edgar F	Oct 21 1887	Philadelphia
1544 Smith Goldwin	Jan y 20 1865	
1789 Smith Stephen	Oct 1 187	New York N Y
2141 Smyth Albert H	May 20 1887	Philadelphia
1742 Snowden A Loudon	Oct 17 1873	
2009 Snyder Monroe B	Jan y 18 1884	
2159 Spangler Henry W	May 15 1891	
1720 Spofford A R.	Jan y 17 1873	Washington D C
1919 Stallo John B	Oct 21 1881	Cincinnati O
1448 Steenstrup J J S	Jan y 17 1862	Copenhagen Denmark
1990 Stevens Walter LeConte	Jan y 18 1884	Troy N Y
1840 Stevenson John James	April 20 1877	New York N Y
2165 Stokes George G	Dec 20 1889	London England
1559 Strong William	Jan y 19 1866	Washington D C
1820 Stuart George	Feb y 2 1877	Philadelphia
2198 Stubbs William	May 15 1891	Oxford England
2094 Suess Edward	May 21 1886	Vienna Austria
2028 Syle E W	July 18 1884	Philadelphia
1844 Sylvester J J	July 20 1877	Oxford England
2092 Szombathy Josef	May 21 1886	Vienna Austria

T

1786 Tatham William P	April 16 1875	Philadelphia
1846 Taylor, William B	Oct 19 1877	Washington D C
2098 Temple Richard Carnac	May 21 1886	Upper Burmah India
2006 Thomas Allen C	Jan y 18 1884	Haverford Pa.
1998. Thompson Heber S	Jan y 18 1884	Pottsville Pa
1726. Thompson Henry	April 18 1873,	London England
1807 Thomson Elihu	April 21 1876	Swampscott Mass
1754. Thomson Frank	April 17 1874	Philadelphia
1729. Thomson William (see Lord Kelvin)	April 18 1873	London England.
1909 Thomson William	April 16 1880	Philadelphia.

	Name	*Date of Election*	*Present Address*
1530	Thury A	April 15 1864	Geneva Switzerland
1658	Tilghman Benjamin C	July 21, 1871	Philadelphia
1233	Tilghman Richard A	April 16 1847	
1657	Tilghman William M	Jan y 21 1870	
2176	Timmins Samuel	Feb 21 1890	Arley near Coventry Eng
2128	Topinard Paul	Dec 17 1886	Paris France
2065	Toppan Robert Noxon	Feb y 19 1886	Cambridge Mass
1597	Townsend Joseph B	Jan y 17 1868	Philadelphia
2024	Trumbull Henry Clay	July 18 1884	
1978	Tschermak Gustav	Oct 20 1882	Vienna Austria
1983	Turrettini Theodore	Dec 15 1882	Geneva Switzerland
2166	Tuttle David K	Oct 18 1889	Philadelphia
2163	Tyler Lyon G	Oct 18 1889	Williamsburg Va
1529	Tunner Peter	April 15 1864	Leobe Austria
2128	Tyson James	May 20 1887	Philadelphia

U

2185	Unwin William C	Dec 19 1890	London England

V

2000	Vaux Richard	Jan y 18 1884	Philadelphia
204	Vere de Schele M	Oct. 16 1885	University of Virginia Va
1475	Virchow Rudolph	Oct 17 1862	Berlin Prussia
1646	Vogt Carl	Oct 15 1869	Geneva Switzerland
2115	Von Meltzel Hugo	Dec 17 1886	Kolozsvar Hungary
1670	Vose George Leonard	Oct 21 1870	Boston Mass
2186	Vossion Louis	Dec 19 1890	Philadelphia

W

2034	Wagner Samuel	Jan y 16 1885	Philadelphia
1748	Wahl William H	Jan y 16 1874	
1724	Wallace, Alfred R	April 18 1873	Parkston Dorset England
2156	Ward Lester F	May 17 1889	Washington D C
2033	Weil Edward Henry	Jan y 16 1885	Philadelphia
2028	Weisbach Albin	Jan y 16 1885	Freiburg Saxony
1639	Wharton Joseph	April 16 1869	Philadelphia
1637	White Andrew D	April 16 1869	Ithaca N Y
1848	White Israel C	Jan y 18 1878,	Morgantown W Va.
1487	Whitney Josiah Dwight	Jan y 16 1863,	Cambridge Mass
1868	Wilder Burt Green	May 3 1878	Ithaca, N Y
2151	Williams, Talcott	May 18 1888	Philadelphia.
2173	Willis Henry	Feb y 21 1890,	
2150	Wilson Edmund B	Feb y 17 1888	Bryn Mawr Pa
2041	Wilson James Cornelius	Jan y 16 1885	Philadelphia
1747	Wilson Joseph M	Jan y 16 1874	
2137	Wilson William Powell	May 20 1887	
2223	Winsor Justin	May 19 1893	Cambridge, Mass,
2140	Wireman Henry D	May 20 1887	Philadelphia
2220	Wistar Isaac J	May 19 1893	
1561	Wister Owen Jones	April 20 1866	
1884	Wood Richard	April 18 1879	
1762	Woodward Henry	July 17 1874	London England
1751	Wootten J E	Jan y 16 1874	Reading Pa
1854	Wormley Theodore G	Jan y 18 1878	Philadelphia

	Name	*Date of Election*	*Present Address*
1082	WURTS CHARLES STEWART	Jan'y 21 1881	Philadelphia
2061	WYCKOFF A B	Feb'y 19 1886	Seattle Wash

Y

1904	YARNALL ELLIS	Apr 16 1880	Philadelphia
1759	YOUNG CHARLES AUGUSTUS	April 17 1874	Princeton N J